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CHEMICAL AGE

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SYNTHETIC RUBBER

LAST week reductions in the prices of US and Canadian synthetic rubbers were announced. These lead to speculation as to the effect on the natural rubber industry. This latter has in recent months endeavoured to maintain competitive and stable prices and, indeed, these have been of considerable assistance in world markets.

Natural rubber production has remained around or slightly below 1.9 million tons, but output of synthetic material has risen rapidly from something like 500,000 tons in 1950 to over 1.2 million tons last year. Synthetic rubber production until quite recently was in the main in the US, with Germany also producing a little. Today, the position is very different. Substantial quantities will shortly be produced in the UK and Italy and when all present plans are fulfilled, the capacity for production of synthetic rubber will be more than present usage of such rubbers. On the other hand the 1957 level of 3.1 million tons is expected to rise to about 4.5 million tons at least by 1965. If natural rubber output is maintained at the present level, the increased requirements for rubber will be met by synthetic rubbers. The danger is, however, that with the vast strides being made in synthetic rubber production, more rubber will be available than can be consumed, and with the development of such a situation, price reductions may be necessary to stimulate additional demand.

Reductions in synthetic rubber prices are not likely to affect the position of natural rubber, it is considered. To effect a changeover to synthetic rubber usage from the natural product is expensive and, other than in an emergency, would be for long-term considerations. Price reductions in synthetic rubbers are seen as resulting from competition between the various synthetic producers to gain markets.

It is markedly apparent, though, that the world market and in particular the European market could easily become saturated due to increasing synthetic rubber production, to the disadvantage of the natural rubber industry, if the price of natural rubber becomes unjustifiable in comparison with the synthetics.

Considering the European situation in a little more detail, there is in Italy ANIC's new factory at Ravenna which is producing synthetic rubber at the stated present rate of 35,000 tons yearly, is later expected to increase to 60,000 tons. In Germany, there is the new Buna-Werke Hüls plant, now capable of producing 70,000 tons of cold rubber (production of 30,000 tons is expected this year—see *CHEMICAL AGE*, 5 July, 1958, p. 13) and is to increase production eventually to 90,000 to 100,000 tons yearly.

International Synthetic Rubber Co. at Fawley with the largest synthetic rubber producing unit in the UK have just started the commissioning of their 70,000 tons a year GR-S plant and an announcement from the company is expected shortly. Dunlop Rubber Co. have a 1,500 to 2,000 tons a year GR-S pilot plant which started last year. Two other synthetic rubber plants which began operations last year were British Geon's plant at Barry producing nitrile (butadiene/acrylonitrile) rubber with an estimated capacity of 5,000 tons a year and Monsanto Chemical's 4,000 tons a year capacity butadiene/styrene resin plant at Newport. Imperial Chemical Industries

also produce a styrene/butadiene rubber, Butakon. Estimated production is 10,000 tons a year. Finally, Du Pont (United Kingdom) are building a neoprene plant in Northern Ireland which is due to start production in 1960.

UK synthetic rubber capacity should be about 70,000 tons per annum by the end of this year.

First butyl rubber works in Europe is that being built at Port Jérôme, near Le Havre. Capacity will be 20,000 tons a year and the plant to be operated by Soc. du Caoutchouc Butyl (Socabu) a venture of Esso Standard and Cie Française des Pétroles, five French chemical concerns and three rubber companies including Dunlop, is expected on stream in October of this year.

There are also plans for a 40,000 tons GR-S plant to be built near the Lacq resources, by Soc. Nationale des Pétroles d'Aquitaine and US. Firestone Tire and Rubber Co. Holland will soon be able to meet domestic requirements and export substantial quantities. N.V. De Bataafsche Petroleum Maatschappij (of the Royal Dutch Shell Group) are building a GR-S plant at Pernis, near Rotterdam, having an initial capacity of 50,000 tons. Algemeene Kunstzijde Unio (AKU) of Arnhem in association with B.F. Goodrich Chemical Co., US, have a synthetic rubber project at Arnhem due to come on stream in mid-1959.

According to Italian Assogomma consumption of raw rubber in Western Europe was 801,900 tons in 1956 of which 152,500 tons (19 per cent) was synthetic. Assogomma estimate that last year about 25 per cent of raw rubber consumed by Western Europe was synthetic. This means about 200,000 tons. (In Italy, 73,000 tons of rubber were consumed in 1957. Of this 20,000 tons (27 per cent) was synthetic).

On the Continent it is felt that a potential surplus of synthetic rubber is likely to materialise in Western Europe by 1960, unless a practical and far-sighted tariff-policy is adopted and unless problems connected with the Common Market are properly studied.

In the meantime, the natural rubber industry has not only to bear prices in mind. It has to consider the rapid development of synthetic rubbers, which are deemed likely to encroach on its, up-to-now, safe field.

SOLUBLE POLYTHENE CATALYST

EXTENSIVE research is being undertaken by Hercules Powder Co., US, on a soluble catalyst for synthesis of highly linear polythene stated to have superior impact and tensile strengths.

The new catalyst, which is soluble in toluene or *n*-heptane normally used as polymerisation medium, is the reaction product of *bis*(cyclopentadienyl) titanium dichloride with diethylaluminium chloride. First disclosure of this catalyst was indicated by a Belgian patent issued in 1956 to Hercules. US Patent 2,827,446 has now been awarded to D. S. Breslow, of Hercules Research Centre.

Unusual properties claimed for this new catalyst include its ability to produce a polymer of high linearity as indicated by its low content of methyl groups. A polymer can be produced containing 0.05 per cent of methyl groups, it is stated, compared to about 0.9 per cent for that made with the Ziegler catalyst (insoluble combination of titanium tetrachloride and an alkylaluminium compound). It is believed, in fact, that the new polymer is almost unbranched and contains a methyl group only at the end of the chain. Melting point of the polymer is 137°C compared to about 132°C for Ziegler low pressure polythene. Infra-red examination has indicated that the new Hercules product has greater crystallinity than the Ziegler material (85 per cent compared to 79 per cent). It also has an unusually narrow molecular weight distribution. Impact strength is given as 7.3 ft. lb. per inch notch (Izod) compared to about 3 for Ziegler polythene and tensile

strength is 3,500 p.s.i. as against 3,000 p.s.i.

This new Hercules catalyst is more complex than the Ziegler type and is more expensive to produce, but this unit cost is cancelled by less catalyst being required to carry out polymerisation. The catalyst is described by Breslow as a blue crystalline solid having, when pure, a melting point of 80° to 90°C (some decomposition on heating occurs). It contains titanium mainly in the trivalent state. However, it is reported that the presence of some tetravalent titanium appears to be essential to high catalytic activity. As the catalyst is highly sensitive to oxygen, small amounts of oxygen will convert the trivalent titanium to the tetravalent form. (Hercules research investigations suggest that the growth of polythene occurs on the titanium.)

There were several reasons for Hercules wishing to investigate soluble catalysts for polythene use. Thus, it was desired to ascertain whether a catalyst surface was required for low pressure polythene. The development of such a catalyst has shown, in fact, that a catalyst surface is not required.

Hercules considered (quite rightly, it was revealed) that a soluble catalyst, since it would be relatively unchanged in concentration during polymerisation, would produce a polymer with a narrow molecular weight distribution. It was also expected that polymerisation would be easier to control. This has indeed proved to be the case for it is possible, Hercules say, to obtain the same molecular-weight-range polymer under a variety of operating conditions.

No plans to use the new catalyst commercially have been announced by Hercules and the company is continuing to use the Ziegler catalyst in commercial production of their Hi-Fax low pressure polythene.

NEW ANTIBIOTIC

DEMONSTRATION of another antibiotic from *Streptomyces flavofungini* is reported from Hungarian workers J. Uri, *et al* (*Nature*, 1958, **182**, 401). The first antibiotic obtained from this strain of *Streptomyces* was flavofungin, an antifungal antibiotic. The presence of the second antibiotic was shown by paper-chromatographic examination of the fermentation fluid and of the crude flavofungin. Organic solvents extract this latest antibiotic, which has been named 'desertomycin' after the source (African desert sand) of the *Streptomyces* strain which produces it.

Desertomycin is described as a white crystalline product for which the empirical formula $C_{33}H_{60}O_{12}N$ has been tentatively suggested. It melts at 189-190°C. Solubility in water, absolute alcohol, ether and acetone is low, but is higher in alcohols which contain some water. It is very stable in neutral aqueous solution. Desertomycin has a C-methyl group, gives acetylated and hydrogenated derivatives, decolorises a solution of permanganate or bromine and gives positive ninhydrin and Kuhn-Roth C-methyl tests.

Minimum inhibitory concentration has been found to vary between 5 and 25 µg./ml. for various micro-organisms. In concentration of 1 to 5 µg./ml. it inhibited *B. subtilis* NTCC6633, *B. subtilis* (streptomycin resistant), *B. subtilis* (penicillin resistant), *B. megatherium*. In a concentration of 10 µg./ml. it inhibited *Staphylococcus aureus* Duncan and *S. aureus* (three strains of penicillin resistant types).

Significant cytotoxic effects were noted in *in vitro* experiments, the antibiotic inhibiting the life-activity of leukaemic cells and of Ehrlich ascites cells in concentrations of 0.7 µg. and 10 µg. respectively.

It exhibits a cytostatic (10 µg.) and in higher concentration (50-100 µg.) a cytotoxic action on fibre blast. Hela and Crocker cells. Institution of bacterial growth appears to be connected with the inhibition of tumour cells.

Foster Wheeler Process for Upgrading Low-Octane Naphthas

RECENTLY designed and constructed by the Foster Wheeler Corporation is a complete catalytic refining-reforming installation at Esso Standard Oil Co.'s Bayway refinery, US. The installation includes a Powerforming unit for the conversion of 20,000 barrels a day of low-octane naphtha into high-octane motor gasoline component and substantial quantities of hydrogen-rich gas. Other units in this plant consist of a feed naphtha splitter, hydrofining unit (i.e., catalytic desulphurisation) and light-ends facilities.

Powerforming, which was developed by Esso Research and Engineering Co., and made available to the petroleum industry in 1955, is one of the developments in catalytic reforming technology. In this process, vapours of low-octane feed mixed with hydrogen gas are passed over a platinum catalyst under prescribed conditions of pressure and temperature to 'reform' the hydrocarbon molecules into molecules possessing high-octane value. It is, in fact, a fixed-bed platinum catalyst which combines dehydrogenation and dehydroisomerisation of naphthenes with dehydrocyclisation of paraffins. Minor reactions are paraffin isomerisation and hydrocracking. A noteworthy feature of Powerforming is the high catalyst activity and long catalyst life obtainable from periodic regeneration of the platinum.

Twenty-three Units

Some 23 Powerforming units with a total capacity of 200,000 bbl., have been completed or are on order. Foster Wheeler have participated in eight of these (total capacity, 80,000 bbl. a day) and is presently building a duplicate of the Bayway installation at La Mede, France.

Naphtha splitter: Flow sequence through the various sections of the Bayway Powerformer begins with the naphtha splitter, where the Powerformer feed is split into a light naphtha (overhead) and heavy naphtha (bottoms). These two splitter products are sent to storage, from which they are charged, in blocked operation, to the hydrofiner-Powerformer. The reasons for splitting and charging light and heavy naphthas separately to the Powerformer is to afford a degree of flexibility in refinery products.

Hydrofiner: From storage, the hydrofiner-Powerformer feed is vaporised and preheated by heat exchange, mixed with hydrogen-rich treat gas (Powerformer product gas from the top of the absorber-stripper), and passed through the fixed bed of catalyst in the hydrofiner reactor. Sulphur in the feed

is reduced to less than 10 p.p.m. by conversion to hydrogen sulphide. Although consumption of hydrogen for desulphurisation is stated to be very low, the treat gas rate must be adequate to maintain a high hydrogen partial pressure in the reaction zone in order to ensure the effectiveness of this mild hydrogenation process.

The catalyst used is cobalt molybdate on a suitable base. It maintains its activity over periods of 12 months or more; even when deactivated it may be brought back to full potency by a simple regenerative technique.

Regeneration in the Powerforming process can be a continuous cyclic operation or in a blocked operation. In the more common cyclic regeneration, a spare or swing reactor is provided so that no interruption in oil processing occurs as a result of regeneration. Blocked regeneration is applicable only where more favourable feed stocks are used, or where moderate octane improvement is required. The entire unit is shut down for regeneration.

Effluent Cooling

Effluent from the reactor is cooled before it enters a separator drum where the gas is separated from the condensed naphtha. The gas flows either to fuel or to other hydrofiners in the refinery as treat gas. Most of the hydrogen sulphide produced in the hydrofiner is carried away in the tail gas from the separator drum, but a small amount remains absorbed in the liquid.

The hydrorefined liquid from the separator drum is pumped to the top tray of the absorber-stripper where it is contacted countercurrently with the Powerformer product gas entering below the bottom tray. The residual hydrogen sulphide is thus stripped from the naphtha while light ends (propane and butane) in the Powerformer gas are absorbed and recovered in the naphtha.

Powerformer: The Powerformer feed, pumped from the bottom of the absorber-stripper is mixed with the hydrogen-rich recycle gas, is preheated by heat exchange and enters the direct-fired preheat heater. The mixture of naphtha vapour and gas, preheated to the desired temperature, enters the first reactor. A temperature drop occurs in each of the four reactors due to the reforming reactions being predominantly endothermic. To bring the reactants back to the optimum reactor inlet temperature, 'reheat' furnaces are included between the reactors. Operating pressure at the outlet of the last reactor is maintained at 300 p.s.i.g.

Effluent from the final reactor is

cooled by heat exchange with several streams in the unit. The effluent from the final reactor is cooled by heat exchange with several streams in the unit. The effluent mixture of reactor liquid product (powerformate) and gas (product and recycle gas) is separated in the Powerformer separator. The recycle gas is compressed and returned to mix with the feed. The net product gas flows to the absorber-stripper.

The Powerformer catalyst: This is known as Esso 1,000 and has the form of cylindrical pellets 3/16 in. dia. by 3/32 in. The active agent is a platinum salt impregnated on a supporting alumina base. Regeneration of this catalyst is a specialised technique, it is reported. It is described, however, as simple and effectively restores the catalyst to 'fresh' activity.

Design reaction severity of the Bayway unit has as its objective the production of a debutanised reformate having a 98 clear research octane number. It is reported that the operating conditions, and catalyst quantity prescribed to obtain this severity with the Bayway feedstock mean a catalyst life of at least one year and probably much longer.

Light-ends facilities: The liquid product from the separator is pumped to the light-ends section, first entering a self-refluxing deethaniser where feed from an ethylene plant is removed as an overhead gas stream; bottoms from the deethaniser flows to a debutaniser where the top-of-column product, essentially propane and butane, is removed as liquid. The bottoms of the debutaniser is the desired product—powerformate.

DSIR to have Scottish Demonstration Pavilion

A £60,000 scientific demonstration pavilion is to be built adjacent to the engineering laboratories of the Department of Scientific and Industrial Research at East Kilbride. This was announced by Sir Patrick Dollan on the eve of his retirement after 11 years as chairman of East Kilbride Development Corporation.

To be built on the lines of a university lecture room, the pavilion will have tiered accommodation for 200 people. It will be equipped with all the apparatus necessary for demonstrations of scientific discoveries and improvements.

New Building for Macaulay Soil Research Institute

Department of Agriculture for Scotland permission has been granted for the erection of the first part of the new £300,000 building to house the Macaulay Institute for Soil Research, Craigiebuckler, Aberdeenshire. With an area of 60,000 sq. ft., the new building will house the laboratories, library and administrative services which up till now have been maintained in the converted mansion house at Craigiebuckler. The institute now has a staff of over 150, including about 40 graduate scientists.

DISTILLATES

★ **ITALITAL**, SpA, Milan, claimed to be the leading European manufacturers of phthalic anhydride with an annual capacity of 37,400,000 lb., are to build a 2,200,000 lb. a year maleic anhydride plant at Scanzorosciate (Bergamo). This will be the first plant of its kind in Italy. I learn that process engineering and major equipment design for the new unit, as well as the necessary technical liaison, will be supplied by Scientific Design, New York, and an affiliated company, Societe Francaise des Services Techniques, Paris.

The SD process produces maleic anhydride by continuous, catalytic, vapour-phase air oxidation of benzene. A patented catalyst and special design features are incorporated.

The Italital plant represents the fourth maleic anhydride project undertaken by SD. Others are the plants of Reichhold Chemicals, New Jersey; Compagnie Francaise des Matieres Colorantes (France), Villiers St. Paul; and the plant now being built for American Cyanamid at Bridgeville, Pa.

★ **DECISION** of ICI Salt Division to cease production of open pan salt at their Winsford, Ches. works, has led Winsford Council to ask Sir Alexander Fleck, ICI chairman, to meet a deputation to discuss the 'serious situation' caused by the contraction of the local salt industry. Winsford Saltmakers' Association has also written to Sir Alexander asking for the decision to be reconsidered. ICI have also been asked to bring new industry to the town.

The division states that ever since 1906, when the Salt Union began making vacuum salt at Winsford, more and more of that type has been sold in place of open pan salt which requires more manpower to produce and is therefore more expensive. Realising that the change-over was economically sound, ICI adopted a policy of replacing open pan salt with vacuum salt and developed special grades of the latter. It was decided to stop production of all open pan salt for the home market by the end of 1958.

Owing, however, to the special needs of the West African market, ICI have undertaken to supply 'Lagos' type salt to customers at a reduced rate until July 1959. To fulfil this undertaking, production of 'Lagos' type will continue at Winsford during part of 1959.

★ **THE FACT** that Bayer of Leverkusen have arranged with a US banking group a \$20 million loan for the Canadian holding company Bayer Foreign Investments (see p. 265), indicates that the possibilities of the domestic German market have largely been exhausted and

that the company are concentrating on their overseas interests. In this connection it is interesting to learn that of the DM. 46,700,000 spent last year by Bayer on acquiring new and enlarging existing financial participations, the major part was accounted for by foreign interests.

The loan now provided by the US banking group would do little more, it seems, than meet the need for outside finance for capital expenditure incurred by the Bayer group in various countries during 1957 and 1958. The transaction is, however, of greater importance than the amount involved now suggests because it may set the pattern for further financial arrangements.

★ **IT HAS** been pointed out to me that our leading article of 19 July on 'Contract research' did less than justice to the pioneer work of Dr. V. E. Yarsley in saying 'There are only two wholly owned British sponsored research institutes and these have been operating for a little over 10 years'. This article discussed the work of the two organisations—Fulmer and Sondes Place—which carry out sponsored research over a very wide field. There are, of course, a number of other companies mainly operating in specialised fields. There is also the large US sponsored Arthur D. Little Research Institute.

Dr. Yarsley's unit—known as Yarsley Research Laboratories Ltd.—covers a wide variety of research projects in and associated with the plastics field. It predates both Fulmer and Sondes Place, having grown out of Dr. Yarsley's consulting practice which was set up in 1931. He first started to 'sell' research as such when he set up his laboratory in Elwell in 1941. Now the laboratories at Clayton Road, Chessington, have a total staff of more than 100.

Dr. Yarsley can reasonably claim to have been among the pioneers of sponsored research in the chemical field in Britain. The organisation is completely independent in the sense that it is not financed by any outside body. It is also a 100 per cent British undertaking and proud of it.

★ **PRODUCTION** of industrial and medical oxygen in new factories in Melbourne, Australia, will shortly be begun by two companies there with overseas affiliations. The two new undertakings will provide the first major competition in Australia for Commonwealth Industrial Gases, which are associated with British Oxygen Ltd.

Pacific Oxygen, which are associated with Adolf Messer, Germany, Coyne Cylinder Co., US, and Gust Holm, Sweden, will begin production this month

at their £A600,000 plant at Spotswood and are already planning to extend manufacturing activities in Sydney, probably next year.

The second company, Industrial Oxygen, will be in full production in September at their £A500,000 plant at West Footscray. This company is owned equally by Industrial Engineering and l'Air Liquide of France. An associate company, Harris Calorific Aust. Pty., in which Harris Calorific, US, has an interest, will make welding equipment.

★ **PREPARE** to meet thy doom! I have not become a prophet of death and disaster, nor will readers see me carrying this dire warning on a sandwich-board. But this 'sentiment', with the addition of a question mark, reflects feelings expressed at the recent Toronto conference of the International Union of Geodesy and Geophysics.

Man, it appears, is burning the carbohydrates stored in the earth's crust much faster than plants can convert carbon dioxide into carbohydrates. The result is an increase in the proportion of carbon dioxide to oxygen in the atmosphere; but before this becomes a toxic hazard, it must increase many times. What is a matter for concern is the indirect effect of increased carbon dioxide on the world's climate.

Since CO₂ absorbs heat radiation, it decreases the loss of heat by radiation and causes a rise in temperature. This in turn causes polar ice caps to melt and the ocean levels to rise. Another factor is the heat energy involved in combustion.

For the first time in the history of mankind, man's operations are reaching a size sufficient to influence the balance of the natural processes on which his life depends. It is to me utterly inexplicable that nowhere in the world is there any broad planning of research into photosynthesis and other biological processes. Unless research is planned, man may be startled one day to find himself in a world in which he cannot live much longer. The same broad criticism can be laid against the current, almost criminal, complacency towards the steady build-up of radioactivity.

★ **A RUMOUR** that appears to have started on the stock exchange and which this week appeared in print in the *Daily Mail* involves ICI in a take-over bid for the share capital of Ilford. Ilford state that ICI have not made a bid for the whole of the capital and decline to say whether the denial covers a closer working arrangement between the two companies to develop ICI's new colour photographic process. ICI Dyestuffs Division refuses to make any comment.

Certainly a closer association between the two companies would be a logical step for ICI have a reputedly first-class colour process but no film-making experience, while Ilford, the major UK photographic film producers, have no colour process.

Alembic

BEHAVIOUR OF SUGAR-BASED DETERGENTS STUDIED AT DURHAM UNIVERSITY

RESEARCH carried out by the public health engineering section of the department of civil engineering, King's College, University of Durham, is indicated in the section's third annual report for the year ended 30 June 1958.

In the year under review, research on algae in sewage treatment has continued. Investigations into disposal and recovery of water works sludge have also continued. The effects of sugar-based detergents on biological processes of sewage treatment are indicated in a first report by D. I. Jenkins, Sugar Research Foundation research student. In the study of production of hydrocarbons from digesting sewage sludge, a gas-chromatograph technique for analysis of gases has been devised. A programme of research is now being initiated into the effect of carbon and nitrogen compounds on sewage biolysis.

Recovery of waterworks sludge: Research assistant I. Vahidi, has continued his investigation of the recovery of alum from wet sludge. The raw sludge (normally on the alkaline side and odourless) kept under anaerobic conditions changes in colour and has a disagreeable odour. It is composed of organic matter, humic acid, and hydroxides of aluminium and iron. Tests have shown that the average amount of Al_2O_3 is about 40 per cent and of Fe_2O_3 4 per cent.

Anaerobic Digestion and Alum Recovery

The effect of anaerobic digestion on the recovery of alum from the wet sludge has been determined on the batch principle. Results obtained to date indicate that anaerobic digestion of alum sludge improves the recovery of alum from wet sludge.

Vahidi suggests that a solution which may be applicable for the recovery of alum is the aeration of the sludge in the presence of certain species of bacteria, i.e. biological treatment. This method will be studied, therefore, on a laboratory bench-scale, using an aeration tank.

Sugar-based detergents and sewage treatment: About 70 per cent of the active detergent material manufactured today is alkyl-benzene-sulphonate (ABS). The 30 per cent includes miscellaneous products, mainly alkyl-sulphates and also non-ionic and cationic detergents. Alkyl-benzene-sulphonates, as is now known, are resistant to biological oxidation. Alkyl-aryl sulphonate detergents have given rise to persistent foam on aeration tanks of sewage works and at river weirs. Detergents based on the higher-fatty-acid (myristic, palmitic, stearic, oleic, etc.) esters of sucrose are envisaged, however, as being one method of alleviating the present problems.

Sucrose esters are being produced on a

pilot scale by the catalysed condensation of sucrose and the methyl ester of a fatty acid in dimethyl formamide solution, reports Mr. D. I. Jenkins (see above). The conversion is by no means complete or consistent, and the resulting commercial products contain, besides various mono-, di- and higher-fatty acid, esters of sucrose, varying amounts of the initial reagents and other by-products, as well as traces of the solvent and its decomposition products.

The following samples of sucrose esters have been received by the section: Sucrodet D-600, Berkeley Chemical Corporation (a sucrose dipalmitate); Sequol-260, Pfizer Ltd. (an esterified cottonseed oil with approximately 2.2 ester groups per molecule); Surfactant SE-957, Pfizer Ltd.; SME-80, Colonial Sugars Ltd. (a mixture of sucrose monopalmitate and monostearate); sucrose stearate, Howards of Ilford Ltd.; sucrose stearate, Herstein Laboratories (81.5 per cent sucrose monostearate); and sucrose monooleate, Foster D. Snell Inc. (82 per cent sucrose monooleate). Carbon-hydrogen microanalysis has shown that Sucrodet D-600 was a mixture of sucrose mono- and dipalmitate in the ratio 36.2 : 63.8.

Isolation of Pure Sucrose Esters

Attempts to isolate pure sucrose esters from the commercial samples by a variety of techniques including, low-temperature fractional crystallisation, reverse-phase chromatography and ion-exchange have proved unsuccessful.

Oxygen-uptake of sewage-seeded distilled water in the presence of Sucrodet D-600 in concentrations ranging from 5 to 100 p.p.m. has been measured under BOD conditions. Increasing the detergent concentration produced an increase in the amount of oxygen utilised by the bacteria in the sewage-seeded water and even at the lowest detergent concentration the sample containing detergent had a higher oxygen-uptake than the blank sample. Sucrodet D-600 has been found to be a bad detergent, 'being difficult to emulsify and impossible to keep in suspension.'

Work on the oxygen-uptake of sewage-seeded distilled water containing Sequol-260, a self-emulsifying material, is in progress at concentrations of 5 p.p.m., of Sequol-260, oxygen-uptake is brisker than that of 25 p.p.m. Sucrodet D-600.

A modified manometric apparatus, based on the Barcroft principle has been built to study the breakdown of these sugar-based detergents by activated sludge. It can also be used to study the effects of higher concentration of sugar-based detergents on respiration of sewage.

Present plans include: determination of

the mechanism of de-esterification; determination of the effect of the detergents on the settlement of sewage; a comparison of the effects of ABS and sugar-based detergents on sewage-treatment process; and determination of the foaming characteristics of the detergents listed above.

Hydrocarbons from sewage sludge:

Gas chromatography can be usefully applied to the analytical investigation of methane fermentation for establishing the possibilities of increasing the hydrocarbon produced by a biological process. Preliminary trials on the analysis of fermentation gas by gas-chromatography are recorded by Dr. J. Chmielowski, trials have been made this year on the analysis of sludge gas by elution by argon from a chromatographic adsorption column packed with activated charcoal or molecular sieve. Detection of separated components of a gas mixture has been achieved using a beta-radiation ionisation chamber. The apparatus consists of a sample-injection system with drying column, manometer, chromatographic column in an electrically heated jacket, beta radiation detector, soap-film flowmeter and argon cylinder. Electrical signals from the ionisation detector are amplified and recorded by a potentiometric recorder.

Gas Samples Measured Under Atmospheric Pressure

Both activated carbon and Linde molecular sieve Type 5A have been employed as column packing ground to 30-60 or 60-100 mesh. A flow rate of carrier argon of about 15 ml./min. has been used which requires an input pressure of 70 to 300 mm. of mercury depending on the absorbent characteristic and length of column. Samples of about 1 to 4 ml. of gas are measured under atmospheric pressure in the tube of known volume connected with a valve system and introduced by carrier argon into the chromatographic column.

A heating jacket of aluminium tube (4 ft. long by 3 in. outside and 9 mm. inside diameter and 200-W electric heater around it) encloses both the chromatographic column and ionisation chamber. Construction of the inlet for the gases emerging from the chromatographic column to the ionisation detector enables the column to be changed easily. Desired temperature is about $120^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$.

Construction of a detector was based on using 10 millicurie of radioactive strontium (Sr^{90}) as beta-radiation source in silver foil in the shape of an open cylinder.

Gas in the cell of the detector is bombarded and ionised with beta-rays from radioactive material. When the walls of the chamber and the radioactive electrode are connected with some source of high potential, the measurements of the current passing between the ionising and the collecting electrodes at different potentials in an ionised gas can be used for analytical purposes.

Ionisation current of the order of 10^{-8} ampères is collected by the central electrode and transferred to the amplifier. Input resistance of the amplifier is 2×10^{-9} ohms and the steady voltage devel-

oped across it by the ionisation current with pure argon flowing in the detector is approximately 20 volts. An equal and opposite voltage is applied to the input of the amplifier from a potentiometric chain so that the indicating meter reads zero for pure argon and gives a positive deflection with argon containing foreign gases or compounds. A Honeywell-Brown potentiometric pen recorder with

2.5 mV of full-scale deflection is used as an indicating meter. To prevent a.c. pick-up additional resistors in series have been inserted.

Analyses performed under sufficiently standardised conditions show that concentration of the hydrogen, methane or other components of sewage gas can be calculated from peak-height measurements.

PROBLEMS OF PRODUCING BORON-10 OVERCOME WITH HIGH NICKEL ALLOYS

SERVING the atomic energy industry in a variety of important applications is boron-10, an isotope of boron. Today boron, because it is 500 times more effective than concrete and 20 times more effective than lead against thermal neutrons, is used in reactor shielding. It is also used in atomic control rods and shows good potential in nuclear instrumentation. Thus instruments measuring neutron densities, have boron-10 coated chambers filled with argon.

Boron-10 is produced by the Hooker Electrochemical Company as contract operator for the US Atomic Energy Commission. The plant, designed and constructed by Singmaster and Breyer of New York, produces about 3 lb. daily of the isotope.

Separation of boron-10 from natural boron is accomplished by the formation of a boron-trifluoride-dimethyl ether complex and its subsequent fractional distillation. The complex undergoes repeated dissociation in the vapour phase and recombines in the liquid phase. Equilibrium slightly favours dissociation of the complex containing boron-11 and recombination of a complex containing boron-10 with the result that boron-10 tends to concentrate in the liquid phase and boron-11 in the vapour phase.

Actual separation of boron-10 from boron-11 is achieved in what is believed to be the world's most effective fractionating system. It consists of six columns, connected in series, the first five each being 20 in. dia. by 65 ft. high and the sixth 6 in. dia. by 25 ft. high. The columns are made of Monel and use $\frac{1}{4}$ by $\frac{1}{4}$ in. cannon protruded Monel alloy packing. The total system Henry Wiggin and Co. of Birmingham report (*Wiggin Nickel Alloys, No. 48*) provides the equivalent of 360 theoretical plates. It takes a minimum of two months for the column to reach equilibrium from cold.

Boron trifluoride used in forming the complex, is brought in in compressed gas cylinders at 1,200 p.s.i. For the addition reaction the pressure is reduced to 40 p.s.i. by means of a reducing valve consisting of Monel nickel-copper alloy and Teflon internal parts. This Monel alloy is used to provide resistance to fluoride corrosion. (Boron in the presence of traces of moisture is rapidly decomposed to fluoboric acid and hydrogen fluoride.

Boron trifluoride and dimethyl ether are mixed in a reactor condenser to form the complex which is introduced into the six Monel fractionating columns. This system has been tested at less than 50 microns absolute pressure and held to a leak rate of less than 50 microns per hour for individual parts as well as for the entire system. Starting with 19.6 per cent boron-10 the complex is enriched to 92-93 per cent boron-10 content.

With agitation and heat the enriched complex is reacted with potassium hydrogen fluoride in aqueous ethyl alcohol to form potassium fluoborate. The dimethyl ether and products of side reactions are removed by evaporation. The reaction takes place in a nickel kettle and the salt is filtered in a Monel filter and, dried in Monel trays.

After filtering and drying, the fluoborate is electrolysed in a potassium chloride bath at 760°C to deposit elemental boron-10 on a cathode produced from Monel pipe. The anode of the cell is a graphite pot surrounded by a shell made of heat-resisting Inconel nickel-chromium alloy. To protect against the KCl-KF-KBF₄ bath operating at 760°C. Monel has been found to give 10 times the life of copper in this service and preserves a clean surface so that the product can be easily removed.

The boron-10 is ground, washed with water and with acid, dried and packed into polythene bags which are inserted in friction-top metal cans. Monel equipment is also used in the water wash.

Continuous Esterification Process Patented

AUSTRALIAN patent No. 206,870-1 has been granted for a continuous esterification process, in which triacetin or tributyrin (triglycerides of acetic and butyric acids) are prepared continuously by passing the reactants concurrently through a column in the presence of a sulphuric acid catalyst, an entrainer which may be the same alcohol, or a C₄-C₈ hydrocarbon being passed counter-currently to remove by-products. A non-volatile ester of e.g. ethylene glycol or glycerol and e.g. phthalic, isovaleric or stearic acid is produced by the same process.

Measurement of Refractive Indices in 2 to 22 Region of Spectrum

CONSTRUCTION and application of a simple interferometer utilising germanium plates is described by R. E. Kagarise and J. W. Mayfield, of the US Naval Research Laboratory, in 'Interferometer measurement of the infra-red dispersion of liquids' (Order PB 131522) obtainable from OTS, US Department of Commerce, Washington 25, D.C., price 75 cents.

The device is said to be capable of producing moderately accurate measurements of refractive indices in the 2 to 22 region of the spectrum. Using the method outlined, refractive indices of carbon disulphide, carbon tetrachloride, chloroform, cyclohexane and perfluoro-1,3, 5-trimethyl cyclohexane were measured with an accuracy of plus or minus 0.003 or better.

ICI's New Nonanol Sprout Depressant

A NEW ICI agricultural product is ICI nonanol sprout depressant, now available for farmers who use indoor storage for their potatoes. Applied by a simple fumigation technique, the product is said to ensure that healthy potatoes will be unwilted and free from sprouts at the time of marketing, no matter how long they have been stored.

It has long been known that alcohol vapour has an inhibiting effect on the sprouting of potatoes. ICI nonanol, which is one of the higher alcohols, is sufficiently active at low concentration to make it a really effective and economic sprout depressant. Supplied in 40/45 gall. drums it is a colourless liquid with a camphor-like odour. Chemically it consists of 3:5:5-trimethylhexanol. Non-corrosive to iron and other common metals, except aluminium, it mixes with water only slightly.

Provan Gasworks Can Utilise Methane Supplies

SCOTTISH Gas Board have at a cost of £2 million modernised Glasgow's Provan gasworks. The works is the largest producer and distributor of gas in Scotland and will be the focal point of the West of Scotland gas grid covering an area of more than 1,500 square miles. It will deliver more than 40 million cubic feet of gas daily into the grid.

The plant is unique because it is equipped to deal with supplies of coke-oven gas and methane as well as for normal gas production.

Methane will be obtained from Cardowan colliery. Crude gas supplies from the coke-ovens of Colville's Clyde Ironworks will be purified and distributed and gas from Bairds of Gartsherrie will be purified.

The modernised gasworks was inaugurated on 11 August by the Lord Provost of Glasgow.

DEVELOPMENTS IN USE OF REDOX INDICATORS

Dr. Belcher Clarifies Misleading Statements

SINCE the first serviceable redox indicator, diphenylamine, was described by Knop in 1924 an extensive range of these indicators has become available. Unfortunately, only a few are of real practical value and there are many conflicting and erroneous statements in the literature concerning their use.

In his lecture 'Developments in use of redox indicators', given recently at a joint meeting of the East Midlands section, Royal Institute of Chemistry, and the Midlands section, Society for Analytical Chemists, at Leicester, Dr. R. Belcher, University of Birmingham, attempted to clarify some of these misstatements and also to describe some new redox indicators with interesting properties. Discussion was confined to indicators used with potassium dichromate, potassium permanganate and ceric sulphate.

Potassium dichromate, with potassium ferricyanide as external indicator, was introduced by Penny in 1850 for titration of ferrous ion. Unlike potassium permanganate, introduced four years previously, the new titrant could be used in presence of hydrochloric acid (in concentrations not exceeding 1N), a point of considerable practical importance. Subsequent attempts to find a suitable internal indicator for dichromate titrations were unsuccessful until Knop recommended use of diphenylamine. This opened a new era in analytical chemistry, many other internal redox indicators quickly being discovered. However, some workers found difficulties when using these new indicators.

Diphenylamine

Difficulties encountered with diphenylamine were not fully understood until its indicator action was examined in more detail. The normally slow oxidation of diphenylamine by dichromate was induced by oxidation of ferrous ions. Oxidation of indicator took place in at least two stages, irreversibly to diphenylbenzidine, then reversibly to diphenylbenzidine violet. The redox potential for this process was 0.7v. Under certain conditions, diphenylbenzidine violet could be further irreversibly oxidised to yellow or red products of unknown composition. A green product, often formed in presence of too much indicator, was an addition compound of diphenylbenzidine and diphenylbenzidine violet.

Diphenylbenzidine had itself found somewhat limited use as indicator in place of diphenylamine. Although the indicator correction was smaller, diphenylbenzidine coagulated rapidly when its solution in sulphuric acid was added to ferrous solution. Reaction with oxidant was then so slow that the endpoint might be passed. When formed in solution from diphenylamine, however, diphenylbenzidine was in colloidal suspension and oxidised readily. It had the same redox potential as diphenylamine, although some workers had ascribed a value 0.06v. higher.

Kolthoff and Sarver had shown diphenylamine sulphonic acid (redox poten-

tial 0.85v.) to have advantages over the two preceding redox indicators. It was much more soluble in water, formed no insoluble addition compound and was without interference from tungstate.

Advantages of both diphenylbenzidine and diphenylamine sulphonic acid should be combined in diphenylbenzidine sulphonic acid. Although its use had been proposed, this indicator (redox potential 0.87v.) had become available commercially only recently. In the lecturer's opinion it was better than diphenylamine sulphonic acid, the most widely used indicator for titration of ferrous ion with dichromate.

N-methyldiphenylamine sulphonic acid (redox potential 0.80v.) had been claimed as the best of the diphenylamine group of indicators. Critical studies had, however, been lacking until recent examination by Dr. Belcher and his colleagues showed its reaction to be far too sluggish, in spite of a sharp endpoint.

Titrations with Dichromate and Ceric Sulphate

For titrations with both dichromate and ceric sulphate, N-phenylanthranilic acid (diphenylamine carboxylic acid) had been recommended. Redox potentials of other diphenylamine-type indicators lay slightly below that of the ferrous-ferric system and it was necessary to add phosphoric acid to lower the potential of the system. Because of its higher redox potential (1.08v.), the addition was unnecessary with N-phenylanthranilic acid. Theoretically (see later), the indicator should be unsatisfactory for titration of dichromate into ferrous. One explanation for this anomaly was that the reported redox potential was too high. A potential of 0.95-0.98v. would account for the observed behaviour; further determinations of its potential were clearly required.

Exact mechanism of the dichromate-ferrous titration was not yet fully clear. An intermediate valency of chromium was involved, there being a jump in potential after starting to titrate, then a drop to the value finally recorded. When dichromate was titrated into

ferrous solution, the equivalence point break in the titration curve lay between 0.85 and 1.00v. In the reverse titration, however, it lay between 1.22 and 0.85v. Doubts had been cast on stoichiometry of the oxidation. Inconsistencies had been reported when detecting the endpoint electrometrically. A positive error of 0.3-0.5 per cent had been found if ferrous solution was titrated into dichromate and a similar negative error in the reverse titration. The same order of errors was reported independently when titrating ferrous into dichromate visually, the ferrous solution having been standardised against standard permanganate. Variations had also been found under different conditions of acidity and concentrations of dichromate.

Ceric sulphate, first used as an oxidant by Lange in 1861, did not become a common titrant until after the independent investigations of Furman and co-workers (visual titration) and of Willard and Young (potentiometric titration) during the period 1928-34. At about this time Knop was carrying out an exhaustive study of triphenylmethane dyestuffs. He found that 25 compounds were suitable as indicators in titrations with permanganate, and subsequently, 12 compounds were selected as being superior to the remainder. Four of these indicators—Erioglaucin A, Eriogreen B, Setoglucin O and Xylene cyanol FF—had been used quite extensively in titrations with ceric sulphate but had now passed out of general use in favour of ferroin.

Confusion caused by too many Trade Names

Certain other triphenylmethane dyestuffs had since been recommended by later investigators, but it appeared that the same compound had been recommended as new more than once owing to the many different commercial names which existed for the same substances.

Diphenylamine-type indicators could be used in titration of ferrous ion with permanganate, although one of the triphenylmethane dyestuffs or ferroin was preferable. There was usually no advantage to be gained with 0.1N solutions of permanganate, owing to their self-indicating properties, but it was advisable to use an indicator with 0.01N solutions.

Diphenylamine and its derivatives were used as indicators in ceric sulphate titrations shortly after this oxidimetric reagent became established. When Kunz showed that the potential of the ceric-ferrous system was 1.44v. (in 1M sulphuric acid), it was appreciated that indicators of higher redox potential—apart from N-phenylanthranilic acid (1.08v.)—were necessary. Triphenylmethane dyestuffs were satisfactory because their redox potentials were all about 1v.

This led to introduction of o-phenanthroline ferrous sulphate (ferroin) as a redox indicator by Walden, Hammett and Chapman, Ferrous-2:2'-dipyridyl was also examined but considered less satis-

factory because it was more readily decomposed. Indicator blank was negligible when ferroin was used with 0.1N titrants. A potential of 1.06c. (in 1M sulphuric acid) was now generally accepted for the colour change, deep red (reduced form) to pale blue (oxidised form). Ferroin was an excellent indicator in titrations with permanganate. Although satisfactory for titrating ferrous solution into dichromate, ferroin was unsatisfactory for the reverse titration because its redox potential was too high for the potential change involved. By increasing the acidity, the dichromate-chromic potential was raised, the indicator potential lowered, and at an acidity of 5-6N dichromate could be satisfactorily titrated into ferrous. These conditions were not to be recommended, however, since ferroin was slowly decomposed by strong acids. Ferroin was probably at its best as an indicator in ceric sulphate titrations.

Both on grounds of theory and practice, there had been many advocates for completely replacing dichromate and permanganate as titrants by ceric sulphate. Dr. Belcher was in agreement with these views. No doubt could exist as to stoichiometry, since no intermediate products were formed by reduction of quadrivalent cerium. Only a one electron change was involved. Most difficulties of redox titrations could be avoided by use of ceric sulphate with ferroin as indicator.

Nitro-ferroin (redox potential 1.25v.), also prepared by Walden and co-workers, was even more stable than ferroin. It was unsatisfactory in ceric sulphate titrations because of its higher redox potential, but it was excellent when a perchloric acid medium was used.

Methyl Groups Led to Decrease of Potentials

Smith and co-workers prepared several other substituted phenanthrolines, determining their redox potentials at varying acidities. The potentials decreased when methyl groups were introduced, change in potential varying according to position of methyl substitution. Furthermore, 2:2'-dipyridyl was re-examined as an indicator and contrary to the original work, it was found sufficiently stable to be used in place of ferroin in ceric sulphate titrations. Personally, Dr. Belcher had found the colour change slightly better using 2:2'-dipyridyl. It could be a cheaper material commercially apart from the existing demand for ferroin. In view of its redox potential (0.97v.), 2:2'-dipyridyl would be expected to behave satisfactorily as indicator in dichromate titrations but this application did not appear to have been examined.

Of certain substituted ferroins recommended for dichromate titrations, the best appeared to be 5:6-dimethylferroin (redox potential 0.97v.). Dr. Belcher had examined this indicator and found the endpoint to be sharp, but in his experience, inferior to that with diphenylamine sulphonic acid and diphenylbenzidine sulphonic acid.

Another indicator of the ferroin group, osmium (II) o-phenanthroline perchlorate, had been proposed for dichromate-ferrous titrations. Critical studies of its application were still awaited, but Dr. Belcher had found the sensitivity insufficient for concentrations greater than 0.1N, so that the indicator was of no real practical value.

There had been some controversy concerning the redox potential of ruthenium 2:2'-dipyridyl, the most recently determined value being 1.25v. (in 1N acidity). Because of its high redox potential, this indicator was unsuitable for titrations with ceric sulphate except when used in perchloric acid medium.

Among more recent redox indicators, Gibson and White's triphenylmethylarsonium chloride was worthy of mention. With permanganate and dichromate, the triphenylmethylarsonium cation formed stable, highly coloured compounds which were readily soluble in such organic solvents as ethylene dichloride. These compounds could be used, therefore, as the basis of oxidimetric titrations with extractive endpoints. The great advantage of such titrations was that they could be carried out in presence of normally interfering, highly coloured cations. In a later publication the same procedure had been recommended for titrations with iodine. Yellow-brown triphenylmethylarsonium iodide was extracted into carbon tetrachloride at the endpoint. Unfortunately, no advantage was mentioned over ex-

traction of iodine itself into carbon tetrachloride to give a violet colour at the endpoint.

Benzidine was too unstable itself for use as a redox indicator. The 3-bromo and 3:3'-dibromo derivatives, prepared by Dr. Belcher and his colleagues, represented the first stable compounds, other than alkoxy derivatives, in the benzidine series. Both compounds worked well as redox indicators with dichromate and ceric sulphate, so that their redox potentials should be in the region of 0.90-0.98v. Values found experimentally were 0.90 and 0.94v., respectively.

Dr. Belcher and his colleagues had also been studying the effect of change of substituents in naphthidine on its redox potential and absorption spectrum. In particular, alkyl and alkoxy derivatives were being investigated but the work was not yet complete.

In conclusion, Dr. Belcher spoke briefly about determination of indicator blanks with diphenylamine-type indicators. Various methods had been used, including titration of a known amount of indicator with a dilute solution of dichromate, difference in titres between visual and electrometric titration, and difference between dichromate titration, with indicator present, and permanganometric titration. None of these methods was entirely satisfactory and Dr. Belcher said it was best to determine the blank in every case under the exact conditions used for a particular series of determinations.

Monograph on 2:4 Xylenol as a Reagent for Nitrate

MONOGRAPH No. 35 (1958) in the series 'Organic chemical reagents', published by Hopkin and Williams Ltd., Chadwell Heath, Essex, deals with '2:4-xylenol-reagent for nitrate'. Authors are J. T. Yardley and T. H. Cooper.

2:4-Xylenol (2:4-dimethylphenol or 1:3-xylen-4-ol) is a white to brownish low-melting solid (or liquid), m.pt 20°-26°C. This and certain other isomeric xylenols have been proposed as colorimetric reagents for estimation of nitrate ion because of the ease with which nitration may be effected and because the sodium salts of the nitration products (nitro xylenols) yield intensely coloured solutions.

Yardley and Cooper describe two alternative procedures for determination of nitrate, one involving steam distillation ('a hybrid of several procedures') and the other employing solvent extract (after Barnes *Analyst* 1950, 75, 388). Using the first method colour intensity has been measured with a Spekker absorptiometer, using a 4-cm. cell, violet filters and with a water setting of unity. Wavelength of maximum absorption determined by the authors, using a Beckman DU spectrophotometer, was 437m μ .

Interference was noted with chloride ions and nitrites. Interference from chloride ions was lessened with lower

acidity leading to better toleration of chloride, but removal is recommended by prior addition of a solution of silver sulphate. Nitrites yielded a colour indistinguishable from that given by nitrate, possibly, it is suggested, due to autoxidation of nitrite. The colour, however, is neither quantitative nor reproducible. Removal is easily effected, it is stated, by warming the solution with urea (as indicated by Buckett *et al.*, *Analyst*, 1955, 80, 141). Special details for estimating nitrate present in soils or in meat and related substances are given.

Symposium to be Held on Nuclear Fuel Cycles

A MEMBER of the British Nuclear Energy Conference, the Institute of Physics is to arrange a symposium in London on 'Nuclear fuel cycles' on 22 and 23 January 1959. The three sessions will be: 1, (a) 'Long term reactivity changes', (b) 'Theory of once-through fuel cycles', (c) 'Perturbations due to fuel cycles'; 2, 'Optimisation of fuel cycles for nuclear power stations'; 3, 'Fuel cycle operational problems'.

Application forms for tickets can be obtained from the secretary of the institute at 47 Belgrave Square, London SW1.

Chemical Requirements of the Semiconductor Industry

New Materials for Future Production

JUST 10 years ago the transistor was invented. It is now apparent that its manufacture, together with the manufacture of rectifiers based on the semiconducting elements silicon and germanium, is about to become a sizeable British industry. It therefore seems opportune to consider what is likely to happen during the next 10 years—particularly in connection with the requirements of this new industry for pure chemicals.

The characteristic feature of the industry is its absolute dependence on the availability of chemicals of the utmost purity. The silicon or germanium used must have an impurity concentration of not greater than one part per thousand million. The production of these elements in such a pure form is a very specialised and difficult business, but it is already being carried out on a moderate scale by a number of chemical and metallurgical firms. The projected requirements in the UK for the next ten years are shown graphically.

Although some germanium is recovered in this country from flue-dusts, the quantity involved is too small and the process is too costly for any major expansion. At the present time it looks as though future British requirements will have to be met by Belgian refiners of ores from the Belgian Congo and South West Africa. The case of silicon is rather different. Here the raw material is, in striking contrast to germanium, very cheap and plentiful—the difficulty is entirely in the extreme purification that is necessary.

Several Processes

There are several processes which are in small-scale production and they all involve the preparation of a volatile silicon compound—e.g. SiCl_4 , SiH_4 , SiHCl_3 to name the most popular—its purification by fractional distillation or other means, followed by thermal decomposition to silicon itself. The present price of around £100 per lb. illustrates the difficulty of this process, but undoubtedly this price will fall considerably as production increases.

Essential steps in the manufacture of transistors and rectifiers are the preparation of the pure silicon or germanium in single-crystal form, the introduction of minute amounts of Group III and Group V elements, fabrication into the required geometrical form and chemical treatment of the exposed surfaces.

Although only small quantities of the Group III and Group V elements listed in Table I are required, they must be very pure. Very precise control is necessary over the geometrical distribution of these added elements in the single crystal silicon or germanium.

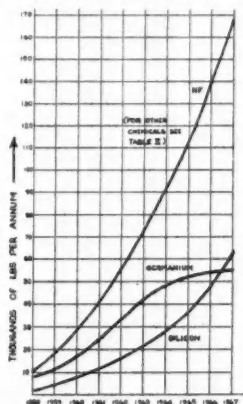
Table I
Main pure elements required by the semiconductor industry

1. Boron	5. Silicon	7. Phosphorus
2. Aluminium	6. Germanium	8. Arsenic
3. Gallium		9. Antimony
4. Indium		

During the fabrication and surface treatment of the transistors and rectifiers a number of pure acids and solvents are

By
Dr. James K. Kendall

In this article exclusive to 'Chemical Age,' Dr. Kendall who is general manager (technical) of Texas Instruments Ltd., Bedford, gives a 10-year forecast of the chemical requirements of the UK semiconductor industry



required, the chief of which are listed in Table II. Here the requirements for purity are not quite so stringent, and commercially 'pure' chemicals are presently being used successfully—although an improvement in purity would be welcome. The quantities which are likely to be required are shown in Table II. As with all the forecasted figures given in this article, there is a considerable amount of uncertainty to be attached to them, but it is hoped that at least the order of magnitude will prove accurate.

Table II
Main pure chemicals required by semiconductor industry

1. Hydrofluoric Acid (as 40% solution)	...	For requirements see graph
2. Nitric Acid (concentrated)	...	40% of HF requirements
3. Acetic Acid (glacial)	...	60% " "
4. Acetone	...	30% " "
5. Alcohol	...	150% " "
6. Water (deionised)	...	300 times " "

In addition to pure acids and solvents, considerable quantities of pure, dry gases are used in the processing of transistors and rectifiers. The chief ones are listed in Table III. Finally, very large

Table III
Main pure gases required by the semiconductor industry

1. Nitrogen	2. Hydrogen	3. Argon
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quantities of deionised water are necessary. Here again, the requirements are stringent and the best water which can be obtained from a mixed-bed deionising column is essential. As the water requirement is roughly three hundred times the HF requirement (i.e. 5,000,000 gall./year by 1967) it is obvious that considerable quantities of pure HCl and NaOH will be needed for regeneration of the ion-exchange resins, but estimates for these are not included here.

Although the manufacture of transistors and rectifiers based on silicon and germanium are the only part of the semiconductor industry considered in this article, it should be realised that the industry properly includes many other activities. Among these may be mentioned the older selenium and copper oxide rectifiers, cadmium sulphide and other photocells, thermistors, non-linear resistors and phosphors for television screens and fluorescent lamps.

Also, in such a rapidly developing field, full-scale manufacture can follow very quickly on original research. In another ten years there will undoubtedly be many other semiconductor devices and materials in production which are now only in the research laboratory. Perhaps the biggest field for new devices will be in connection with thermo-electric power generators and refrigerators. Among new semiconducting materials may be mentioned the Group III/Group V compounds such as InAs, InSb, GaAs, etc., silicon carbide, bismuth telluride and many others.

Chemical requirements for all these other fields will be similar in kind to those detailed above—but they may make the total usage of the semiconductor industry as a whole very much larger than the figures which have been suggested.

Euratom's Uranium Resources Below Requirements

ACCORDING to the Euratom Commission's first report, reserves of uranium in the Shinkolobwe mine in the Belgian Congo are practically exhausted. The Congo has been producing about 850 tons of uranium annually, and three-quarters of it is still under option to the Anglo-US Combined Development Agency.

France is still the main source of uranium in Europe, and mines have been opened in four centres where there are proved reserves of 15,000 tons and reputed total resources of 10 times that quantity.

Treatment capacity of the French concentration plants is expected to reach 800 tons of metal by 1959, and 1,500 tons by 1961—figures well below Euratom's requirements.

MORE THAN 300 PAPERS FOR BRITISH ASSOCIATION AGM

ANNUAL meeting of the British Association for the Advancement of Science is to be held this year in Glasgow University buildings from 27 August to 3 September. About 320 speakers will take part in the meeting and quite a number of papers pertinent to the chemical and allied industries will be given.

Among others, the following papers should prove of particular interest: Chemistry of transuranic elements *Professor H. J. Emeléus*; control of nuclear reactors *Mr. J. Walker*; silicone polymers—an introduction to their properties *Dr. G. Freeman*; phosphonitric halides—aromatics without carbon *Mr. N. Paddock*; applications of a thermal comparator *Dr. R. Powell*; measurement of molecules by X-rays *Professor J. Monteath Robertson*; rebirth of organic crystallography *Mr. P. Pauling*; how molecules fit together *Mr. H. Powell*; heat and the engineer *Professor O. A. Saunders*; heat transfer and pressure loss with gas flow across banks of finned tubes *Mr. J. Miller and Mr. G. Reising*; storage of energy *Mr. R. Voysey*; nuclear power and the engineer *Sir Christopher Hinton*; aspects of thermonuclear power *Dr. T. Allibone*; some recent applications of chemistry to metallurgical problems *Professor R. Hay and Dr. P. Carter*; newer metals in industry *Dr. H. Finnieston and Dr. P. Murray*; corrosion behaviour of some of the newer metals; choice and valuation in industrial research *Mr. R. Lodge*; some (lubrication) problems in travelling at 2,000 m.p.h. *Dr. F. Bowden*; rolling, skidding and sliding *Dr. D. Tabor*; lubrication in the nuclear age *Dr. C. Williams*; newer aspects of fluid lubrication *Dr. F. Barwell*; fluorocarbons—a new branch of organic chemistry *Dr. J.*

Tatlow; industrial advance of fluorine *Mr. H. Leech*; physiological properties of toxic organic compounds containing fluorine *Dr. B. Saunders*; development and use of technical ideas in a small-firm industry *Mr. H. Baker*; application of microwave physics to the study of the solid state *Dr. K. Stevens*; technical applications of microwave physics *Dr. D. Ingram*; applications of atomic and molecular resonance phenomena to microwave technology *Mr. I. Ross*; vaccines and parasitic worms *Dr. W. Mulligan*; physics of quanta *Professor P. I. Dee*; use of high-energy quanta in nuclear investigations *Mr. J. Reid*.

Excursions will include ones to the Hannah Dairy Research Institute; British Hydrocarbon Chemicals; BP Refinery and ICI Dyestuffs Division at Grangemouth; John Brown & Co. (Clydebank); Colvilles; Mechanical Engineering Research Laboratories; ICI Nobel Division; North British Aluminium Co.; AEA Chapelcross; Distillers Co.; Boots Pure Drug; and the Fuel Research Station.

Correspondence concerning the Chemistry Section should be addressed to Dr. B. J. Mason, Imperial College, London SW7.

Cosmetic Science Congress

The British Congress of Cosmetic Science will be held at University College, London, on 15, 16 and 17 April, 1959. The programme of papers is divided into four sessions on analysis of raw materials, assessment of finished products, manufacturing or processing, and biological assessment. Application forms may be obtained from Dr. R. H. Marriott, c/o County Laboratories Ltd., Honeyot Lane, Stanmore, Middx.

Geigy Investigations on Plastics Resistant to Gamma Radiation

ELASTOMERIC materials used in atomic power stations and laboratories, such as gaskets, flexible sheathing, coverings, etc., have to operate at somewhere near ordinary temperatures (0° to 30°C) under bombardment from the radiations (especially gamma radiation) of nearby radioactive materials. Investigations of the behaviour of elastomeric materials inside the pile shielding have already been reported, but conditions inside the biological shield differ greatly.

The Atomic Energy Research Establishment in conjunction with The Geigy Co. Ltd., have recently concluded the first stage of an investigation into the behaviour of plasticised polyvinyl chloride under intense gamma radiation. The first results of this joint work, published in AERE Report No. E/R2518, 'The degradation of plasticised p.v.c. compositions under high level gamma radiation', show that the behaviour of plasticised p.v.c. varies widely according to the kind of plasticiser used, and that the best of the plasticisers so far examined is Geigy's tritolyl phosphate (formerly called tricresyl phosphate).

IAEA Plans To Channel Radiation Information

TO HELP member countries of IAEA to acquire the knowledge and skills needed to make full use of radioisotopes and radiation sources, special composite isotope teams are being formed, details of which are now available to less-developed areas. This was announced by the board of governors in a review of the first eight months of operations of the International Atomic Energy Agency.

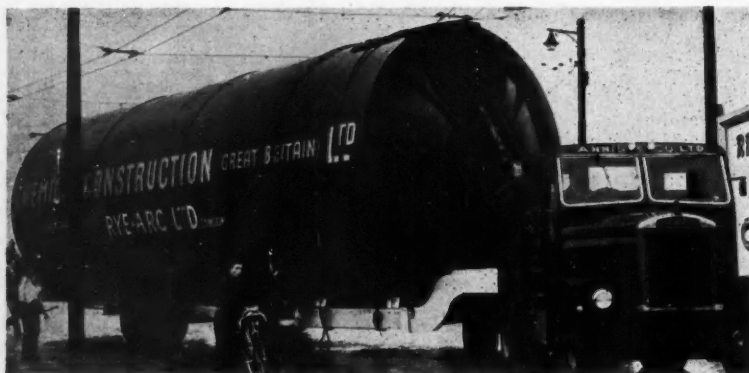
A world-wide survey is being made of national and commercial catalogues of radioactive materials so that an international catalogue of radioisotopes can be compiled.

IAEA's scientific and technical documentation service is now established, over 40,000 publications and documents having been received, and plans are being formulated for the dissemination of scientific and technical information. An international reactor directory dealing with all types of power, research and training reactors in existence or under construction is to be published.

Diaphragm Feed Pump Tests

At the Nuclear Science and Engineering Conference, Chicago, C. H. Gabbard of the Oak Ridge National Laboratory read a paper on 'Diaphragm Feed Pumps for Homogeneous Reactors'. Problems encountered in the development of a 1.5 g.p.m. high-pressure, low-capacity diaphragm feed pump were discussed. The author describes work on (1) contour shape and stress present in the diaphragm, (2) methods of studying dynamic deflection, and (3) uranyl-sulphate solution corrosion of certain types of steel.

Sulphuric Vessel for British Titan



This 20-tons absorption tower, 16 ft. in diameter and 44 ft. long, was recently transported from the Silvertown works of Rye-Arc Ltd., where it was fabricated to the Billingham works of British Titan Products Ltd. With a continuous police escort the journey took four days. The vessel is part of a 250 tons a day Chemico sulphuric acid plant supplied by Chemical Construction (Great Britain) Ltd. and now being constructed

Overseas News

AUSTRALIA BUILDS TO BRIDGE PRODUCTION GAP IN PETROCHEMICALS

CURRENT production capacity of Australia's seven oil refineries is more than 10 million tons a year. The eighth refinery, nearing completion in South Australia, will lift the total to nearly 12 million tons and make Australia independent of all overseas refineries for motor spirit and leave a surplus of other products for export.

Meantime, three Australian refineries have asked for an increased duty on imported petrol, and the Tariff Board is to hear the application in September.

Australian refineries used 2,360,000 tons of crude oil during the first quarter of 1958, compared with the 1957 quarterly average of 2,100,000 tons. Motor spirit accounted for 33 per cent of the refinery output. Exports of refined products rose sharply to 385,000 tons, compared with last year's quarterly average of 219,000 tons.

A carbon black plant designed to produce 75 per cent of the requirements of Australian tyre manufacturers is to be built at Altona, an industrial district near Melbourne, at a cost of £A2 million.

Most of the 16,000 tons of carbon black now imported each year comes from Britain, the balance being obtained from the US and Canada. Partners in the new project are US firms Godfrey L. Cabot Inc., and the United Carbon Co., of West Virginia, and a Cabot subsidiary, the Cabot Engineering Co., will design and build the plant. Components valued at £A750,000 will be bought in Australia. The production method is to be the furnace process in which heavy oil is burned in enclosed furnaces at high temperatures.

Bayer Secures Loan for Foreign Investments Company

Farbenfabriken Bayer AG, of Germany, have secured from a US banking consortium, headed by J. P. Morgan and Co., of New York, a \$20 million medium-term loan to consolidate and expand their foreign interests held by Bayer Foreign Investments, Toronto, Canada (see CHEMICAL AGE, 26 July p. 159). The consortium includes the Bank of America, Canadian Bank of Commerce, Chemical Corn Exchange Bank, First National City Bank and Schweizerische Kreditanstalt.

Indian Oxygen Plan Increases Oxygen & Acetylene Capacities

Larger oxygen and acetylene capacities are being planned by Indian Oxygen Ltd. to meet the heavier demands expected from the Tisco works' expansion programme of the Tata Iron and Steel Co., Jamshedpur, India, which will give an output of 2 million tons of ingots per year.

Oxygen is being used for cutting and

deseaming operations and in Tata's scrap recovery process. LOX (liquid oxygen explosives) is also being used at the company's iron ore mines. This use of oxygen is being widened in view of the economies which result in comparison with the use of conventional explosives.

In all, Tisco's annual consumption of oxygen has increased tenfold since 1935, it is reported.

Dutch Firm's Increasing Pharmaceutical Output

The board of Kon. Nederlandsche Gist- en Spiritusfabriek, NV, Delft, reports that the unsatisfactory results last year in their yeast and spirit works were offset by higher yields in their pharmaceutical sections. A new type of penicillin for oral administration was introduced under the name of Acipen. Turnover of streptomycin was stepped up and sales of fully-synthetic chloroamphenicol, marketed as Globenicol, were satisfactory. A new pilot plant will be opened in the near future in the firm's biochemical department.

German-French Synthetic Rubber Project in India

India is interested in setting up a synthetic rubber industry. The first project is that of the US Firestone Tire and Rubber Co., Akron, Ohio. Another project being investigated is that of ethylbenzene manufacture required for styrene production. This will have to come from a remote sited plant.

According to recent press announcements by the Indian Government, a French/German consortium is investigating possibilities. The proposal of the consortium is for a 20,000 tons plant based on natural gases from the Nalsor-katiya refinery.

Cost of this project would be about 130 million rupees; of this sum 80 million rupees would be obtained from foreign exchange and the consortium will make available the remainder as credit to be repaid over a 7 to 10-year period, beginning the fifth year after the project is completed.

Wacker-Chimie's Interest in ANIC of Ravenna

A special section has been developed at the petrochemical works of ANIC in Ravenna to cover vinyl chloride and methane base. This division employs 150 people and is known as Societa Chimica Ravenna. It is jointly owned by ANIC (51 per cent) and Wacker-Chimie GmbH of Munich (49 per cent). Wacker will take the greater part of monomer produced by the division and will polymerise it at Munich.

ANIC is 53 per cent owned by state

enterprise ENI (Ente Nazionale Idrocarburi) and the remaining 47 per cent by private shareholders.

Italian production of vinyl chloride was 70,000 tons. This is about 10 per cent of total world production of vinyl chloride. More than 50 per cent of the Italian production is exported.

Methane consumption for chemical synthesis in Italy amounted to 359 million cu. m. in 1957. The average price paid for methane by the chemical industry in that year was lire 8.95 per cubic metre; this price includes transport costs and fiscal dues.

New Coal Tar Enamel Plant for South Australia

A new plant—the first of its kind in Australia—has been set up at Brompton by Tar Products Pty Ltd. to convert coal-tar gas into enamel for protecting underground pipes. Research has shown that the best way to protect underground pipes is with a coating of high dielectric strength and high water resistance, supplemented if necessary by cathodic protection.

Spanish Fertiliser Output Increasing

The Sociedad Espanola de Fabricaciones Nitrogenadas SA are to increase ammonium sulphate production to 160,000 tons a year. Supplies of fertilisers in Spain are still below requirements, for although deliveries in the north have recently increased—though too late to benefit the early crops—a shortage persists in the Valencia area.

Naarden Chemicals Profits Up

Sales of chemicals by the Naarden Chemical Works, Holland, were up by 6 per cent last year. Gross profits rose by 23 per cent to fl. 2.3 million, and a dividend of 10 per cent has been declared. The firm exported nearly 75 per cent of its output.

Sulphur Beds Near Rome May Yield 10 Million Tons

Soundings carried out at the 300-acre sulphur deposit discovered recently at Pomezia, a few miles south-west of Rome, indicate that it contains about 10 million tons of fine quality sulphur. As the sulphur lies close to the surface, it will be possible to mine it at low cost. According to some reports an American and an Italian Company have already planned to build a factory on the spot to produce about 30,000 tons of triple-phosphates yearly.

USAF Rocket Propellant Studies Contract For US Borax Research

The US Air Force has awarded a contract for the study of high temperature inorganic polymers and the chemistry of new solid rocket propellant components to US Borax Research Corporation, Anaheim, California, the research subsidiary of US Borax and Chemical Corporation, operating company in the US for Borax (Holdings) Ltd.

The contract, which will be carried

out in co-operation with the Materials Laboratory of the Wright Air Development Centre, is in support of research on inorganic polymers and plastics, resulting from the requirement for new materials that will withstand temperatures of 1,000°F in missile and aircraft applications. Present day polymers based on organic-carbon compounds are unstable at these high temperatures but it is predicted from theory that inorganic materials containing little or no carbon, will be thermally stable. The exact nature of the inorganic polymer components to be investigated in connection with this contract has not been disclosed but it is expected that boron, nitrogen and aluminium will occupy an important place in the development programme.

New Plastics Plants Planned for the Argentine

A contract which Industrias Plasticas Argentinas Koppers, a subsidiary of Koppers Co. Inc., of Pennsylvania, US, have signed with Yacimiento Petrolifero Fiscales, a state-owned oil company, for the construction of ethylene and polythene plants at La Plata, is contingent on the approval of the Argentine Government. Koppers state that most of the capital is to be raised in Argentina, and under the agreement YPF would supply gas from its refineries to the plastic plants.

Determination of Copper in Copper-ethylene-diamine

A method is described by Josef Sára and Wolfgang Berndt (Spolana n.p. Neratouice, Czechoslovakia) in *Svensk Papperstidning* (1958, 61, No. 11, 353) for the determination of copper in copper-ethylene-diamine solution. The method involves addition of an excess of Komplexon-III solution and back-titrating of the excess at pH 5 with a lead and zinc salt solution against xylenol-orange or methyl thymol blue.

Austrian Nitrogen Production Increased

Production of nitrogen at Österreichischen Stickstoffwerke, Linz, reached a total of 906,300 tons compared with 756,400 tons in the preceding year, an increase of 20 per cent. The total taken from this production for nitrogen fertilisers stayed unchanged at 80 per cent; in 1957 this production reached 724,800 tons (606,000 tons in 1956). Regarding sulphuric acid, cement and superphosphates, there was a 10 per cent increase in production compared with the preceding year. For other manufactures, such as complete fertilisers, humus-based fertilisers, phytopharmaceutical products and chemical products, there was almost an 80 per cent increase.

Sales realised passed the Austrian schillings 90 million to 110 millions. Exports formed the same percentage (60 per cent) as for 1956. Domestic sales as well as export sales were up by 22 per cent. About three-quarters of the total sales of nitrogen fertilisers were destined for export, reaching a volume

of 625,800 tons. Compared with 1956, the quota for Europe increased from 53 to 56 per cent that for Africa from 13 to 17 per cent, that of the US stayed unchanged at 1 per cent; while that for Asia showed a decrease from 33 to 26 per cent. Austria nitrogen products have gained an entry into the Indian market and sales of these products have increased in Egypt.

In January this year a new factory for urea came on stream. Sales of this product have already been effected. In October last year a new sulphuric acid plant based on sulphur came into operation. This has increased acid capacity at Linz to about 75,000 tons a year and will allow the production of more than 80,000 tons of superphosphate a year.

Italian Equipment For New Turkish Chemical Plant

A large chemical plant costing the equivalent of £4 million pounds is being planned in Turkey. About £2½ million worth of equipment is to be bought in Italy. Negotiations are still going on, but it is understood that the goods would be paid for in five years and that this credit would be guaranteed by the Turkish Ministry of Finance.

Corrosion Protection By Sodium Nitrate Solutions

Russian work reported in *Automobil Traktor. Prom.*, 1957, 2, 40, indicates that ferrous metal car parts were protected from corrosion by immersing the washed and degreased parts for 5 minutes in 25 to 30 per cent sodium nitrite solution, draining, then wrapping in Kraft paper moistened with the same solution.

Parts treated in the above manner are stated to have remained free of corrosion for one year when stored under varying humidity conditions and at temperatures from 35° to -20°C. Chromium and nickel specimens were also well pre-

served by this treatment. Zinc specimens, however, were attacked by the sodium nitrite.

Harbin is New Development Area for China's Chemicals

A concentration of chemical activity is growing up around the Harbin district of China. According to reports, the construction of 31 new chemical plants is planned for this year, and by 1962 there should be in operation 65 large and medium-scale chemical factories, including a synthetic fibres plant with an annual output of 6,000 tons of caprone, a synthetic rubber plant with an annual output of 2 million tons, two gas plants and factories producing sulphuric acid, caustic soda and calcium.

Work on the construction of a fertiliser factory with an annual output capacity of 800,000 tons of ammonium sulphate has begun in Hefei, Anhwei Province. All processes will be automatic and the first stage should be completed by 1960.

German Company will Make Titanium from US Know-how

A 'know-how' agreement has been concluded by the Titanium Metals Corporation of America with the Deutsche Edelstahlwerke, of Kreseld, a member of the Thyssen group, under which the German company will manufacture titanium metal.

Coal Hydrogenation Plant for China

The Soviet Union is to erect a coal hydrogenation plant at Fushun for China. Bituminous coal from the neighbourhood of Fushun will be used. Pilot trials by the USSR have indicated that 60 barrels of fuel oil and fuel oil products, etc., can be obtained from 100 tons of coal.

By 1962, China hopes to produce 15,000 barrels of fuel oils, etc., either from synthesis routes or shale oil.

Australian Sulphuric Acid Production

THE Sulphuric Acid Executive Committee, Dept. of Defence Production, Australia, has given the statistics shown below in respect of sulphuric acid production and supply of raw materials. Figures for superphosphate production

during the same three quarters are still subject to revision. Provisionally, however, they have been stated in tons as: Made 504,740 (last quarter, '57), 568,418 (first, '58), and 566,856 (first, '57); Sold 278,349, 976,512 and 948,607.

Sulphuric Acid Production mono tons							Quarter ended		
							31/12/57	31/3/58	31/3/57
Ex brimstone	...	...	...	...	...	...	103,969	127,238	125,643
Ex pyrites	...	...	...	...	...	...	77,232	75,487	78,663
Ex zinc concentrate	...	...	...	...	...	...	28,320	26,431	23,451
Ex spent oxide	...	...	...	...	...	...	4,556	3,875	3,105
Ex other materials	...	...	...	...	...	...	18,471	19,555	13,837
Process { chamber	...	...	...	...	...	...	123,447	148,750	145,461
contact	...	...	...	...	...	...	109,101	103,836	99,238
Total production	...	...	...	...	...	...	232,548	252,586	244,699

Raw Materials for Acid Manufacture tons							Quarter ended		
							31/12/57	31/3/58	31/3/57
Brimstone	...	...	...	...	...	...	35,432	43,484	42,460
Pyrites	...	...	...	...	...	...	62,321	60,638	64,368
Zinc concentrate	...	...	...	...	...	...	36,909	34,441	30,054
Spent oxide	...	...	...	...	...	...	4,352	3,657	3,019
Other materials	...	...	...	...	...	...	73,320	72,135	58,597

● **MR. NORMAN SHELDON**, vice-president of the British Association of Chemists, has been elected county councillor for the Teddington Division of Twickenham.

● **MR. S. F. SMITH**, sales manager of the industrial instruments division of Firth Cleveland Instruments Ltd., Treforest, Glam., is visiting agents in Amsterdam this month to further the sales of British-made equipment in Holland. He will be accompanied by **MR. D. T. BROADBENT**, an executive director and chief engineer.

● **W. ADRIAN KING** has been named vice-president of the chemicals division, Olin Mathieson Chemical Corporation. Mr. King was previously general sales manager for the industrial chemicals division.

● **MR. P. A. BRIDGE** has been appointed general manager of the Dunlop Hose Division.

● **British Oxygen Co. Ltd.** have awarded three postgraduate fellowships to: **MR. P. G. CLAY**, B.Sc., of King's College, Newcastle upon Tyne, for research in the chemistry department at the College; **MR. R. E. RAAB**, B.Sc., of the Natal and Oxford Universities, for research in the Oxford Physical Chemistry Laboratory; and **MR. G. SAVILLE**, B.A., of Oxford University, for work in the Oxford Inorganic Chemistry Laboratory. Renewal of fellowship for a third year has been granted to **MR. N. G. PARSONAGE**, B.A., for work in the Inorganic Chemistry Laboratory at Oxford University.

● **DR. S. KRISHNA**, scientific adviser to the High Commission for India and the Scientific Liaison Officer for India, will relinquish his post on 18 August. His successor has not yet been named but the charge of the office will be held temporarily by **MR. B. SEN**, assistant educational adviser, India House, Aldwych, London.

● **Wm. Neill & Son (St. Helens) Ltd.** have announced that following the death of **MR. J. H. LAITHWAITE**, late chairman and managing director of the company, **MR. A. E. W. BAINES**, was appointed chairman and **MR. JOHN (JACK) LAITHWAITE (I)** and **MR. JOHN LAITHWAITE (II)** were appointed joint managing directors.

● **DR. M. F. JORDAN** has joined Murex Welding Processes Ltd., Waltham Cross, Herts, as leader of the fundamental research section of the research department. In this capacity he succeeds **DR. W. D. BIGGS** who has now left the company to take up an appointment in the engineering department of Cambridge University. Dr. Jordan graduated in 1951 with an honours degree in industrial metallurgy at Birmingham University and subsequently became a member of the 'joining of metals' research team at the University. He carried out an investigation of the mechanism of oxide removal from aluminium by brazing fluxes and for this work he was awarded his Ph.D. Before joining Murex, Dr. Jordan was

PEOPLE in the news

on the staff of the Aluminium Laboratories Ltd., Banbury. **MR. H. J. WELLARD**, who has also joined the fundamental research team of Murex Welding Processes, obtained his B.Sc. at Bristol University in 1945 and under the direction of **DR. H. F. KAY** at the University undertook research on the phase transitions in barium titanate. In 1949 he joined the British Rayon Research Association, Manchester, and up to his present appointment was engaged on investigations by X-ray crystallography of the structures of fibre-forming polymers.

● **MR. F. S. D. BROWN**, technical adviser to Eastern Counties Farmers Ltd., has been awarded a Ford Foundation-English-Speaking Union travel grant to the U.S. His main duties are in connection with the formulation of feeding stuffs manufactured at the society's provender mill, and with laboratory control of quality.

● **MR. A. C. ALLISON**, of 61 Latimer Gardens, Glasgow SW2, has been appointed technical representative in Scotland of Nordac Ltd., chemical engineers, of Uxbridge, Middlesex.

● **MR. T. MORRISON** has been appointed instrument sales manager of the Solartron Electronic Group Ltd., Thames Ditton, Surrey, for the UK. The sales areas have been re-organised into three regional groups under **MR. DENNIS P. TAYLOR**, south-west, **MR. DAVID R. HALL**, south-east, and **MR. TERRY BLACKLOCK**.

North of England and Scotland. These changes have been because of the continued expansion of sales of the group's electronic instruments, now running at an annual rate of well over £2 million.

● **SIR ERIC SPEED** and **MR. W. W. H. HILL-WOOD** have resigned from the board of British Celanese.

● **DR. ROBERT KENEDI**, principal lecturer on 'Strength of materials' at the Royal College of Science and Technology, Glasgow, has been invited by a Peruvian University to lecture and assist in organising engineering studies, and to advise on the purchase of laboratory equipment.

● **DR. R. G. GIOVANELLI** has been appointed as the new chief of the CSIRO Division of Physics (which is part of the National Standards Laboratory, Sydney), in succession to **DR. G. H. BRIGGS** who will be retiring shortly.

● **MR. J. BOYD**, Nobel division engineering instrument section, Imperial Chemical Industries Ltd., has left for India where he will supervise and inspect instruments in ICI's Gomia factory which is now approaching the start-up date. At the beginning of September, **MR. A. WALES**, blasting department, Ardeer, and **MR. C. M'INNES**, acids department, will leave for the same factory. Mr. M'Innes will help at the start-up of the acids plant and Mr. Wales will be concerned with the start-up of the nitroglycerine manufacture and will assist generally during the first stages of the blasting department operation Gomia.

Obituary

DR. WILFRID TAYLOR, a joint deputy manager of ICI Nobel Division, Research Department, Stevenston, Ayrshire, has died in hospital, aged 59. He served for some 30 years in the Nobel Division ICI, took part in many research projects and sat on Government committees. He trained at Durham, worked under Sir John Thomson at Cambridge and was Pemberton Fellow at Durham University in 1926 and Earl Grey Memorial Fellow in 1927.

Opening the new head offices of Honeywell Controls Ltd. at Greenford, Middlesex, is Harold Sweatt, chairman of the Honeywell organisation. With him, l. to r., are V. D. MacLachlan, director and general manager; Mayor of Ealing; and E. C. Vorlander, managing director. The new building houses sales and service engineering and export departments, a training school, and the London branch office



WIDE RANGE OF CHEMICALS INVOLVED IN KID CHANGES

EXEMPTION from Key Industry Duty is extended until 31 December 1958 for all articles exempted by previous orders which expire on 18 August, with the following additions and deletions. This is effected by a Treasury order, Safeguarding of Industries (Exemption) (No. 5) Order, 1958. Copies of the new Statutory Instrument are obtainable, price 6d net or 8d by post, from HM Stationery Office, Kingsway, London WC2 and branches.

Additions

Component parts of scientific instruments: crystals of europium activated lithium iodide weighing not less than 2.5 G. each; crystals of thallium activated caesium iodide weighing not less than 2.5 G. each.

Synthetic organic chemicals, analytical reagents, other fine chemicals and chemicals manufactured by fermentation processes, the following:—

Ammonium thiocyanate; calcium dichromate; carboxymethylcellulose, aluminium salt *o*-mono Chlorobenzaldehyde; dimethylamine; dimethyl *p*-nitrophenyl thiophosphate; diphenyl ether with a crystallising point not less than 26.5° C.; 17-hydroxycorticosterone labelled with radioactive carbon of atomic weight 14.

L-lysine dihydrochloride; magnesium carbonate in the form of 2 ounce blocks measuring approximately 4 in. by 2½ in. by 2 in.; methyl *n*-hexyl ketone of a purity not less than 85 per cent; 1-nitropropane; 2-nitropropane; *n*-octoic acid; zinc diamylthiocarbamate.

Deletions

Compounds of rare earth metals; cerium oxide, pure.

Synthetic organic chemicals, analytical reagents, other fine chemicals and chemicals manufactured by fermentation processes, the following:—

mono acetylacetone; *o*-aminodiphenylmethane hydrochloride; barium manganate; benzylcellulose; bismuth oxychloride, crude; butacaine sulphate; *n*-butyl alcohol; mono-*tert*-butyl-4-hydroxyanisole; calcium 2-iodoxybenzoate; (—) carvone; *m*-mono chloroacetophenone; 3-chloroaniline.

N-*p*-Chlorobenzyl-*N*'*N*'-dimethyl-*N*-2-pyridyl-ethylene diamine hydrochloride; 2-*p*-chlorophenylene diamine hydrochloride; 2-*p*-chlorophenoxyethanol; 2,6-diamino-3-phenylazopyridinium chloride; 2,6-ditertbutyl-*p*-cresol (—OH = 1); ditertbutyl diperphthalate; dicyandiamidine phosphate; dimethyl isomylethylmalonate; 2,6-dimethylheptan-4-ol; 3,7-dimethyl-*n*-octaldehyde; *p*-(di-*n*-propylsulphamyl) benzoic acid.

Ethyl abietate; ethyl 2-benzoylbenzoate; ethyl 4:4'-dihydroxydicoumarinyl-3:3'-acetate; ethyl 3:3'-di-4-hydroxyphenylpropionate; ethyl 13:14-di-iodobehenate; ethylene brassylate; ethyl *o*-hydroxy-*o*-methyl-*n*-butyrate; ethyl lactate; ethyl linoleate; *N*-ethyl-3-piperidyl benzylate methobromide; *N*-ethyl-3-piperidyl diphenylacetate hydrochloride; 5-ethyl-2-sulphanilamide-1:3:4-thiadiazole.

4-Hydroxy-2-aminopyrimidine; menthyl mono-ethoxyacetate; 3-mercaptopropane-1:2-diol; 3:2-mercurioxy-4-nitrotoluene; 4-methylpentan-2-ol; β -picoline; piperonylic acid; 3-pyridylmercury acetate.

Safrole (not including *iso* safrole); *R*. sodium sulphate; sodium 2:4:5-trichlorophenoxide; sodium xanthate; strontium 2-ethylhexoate; tetraisopropyl orthotitanate; *R*. titanium dioxide; toluene-*p*-sulphondichloroamide; toluene-2,5-diamine sulphate; 3:3:5-trimethylcyclohexyl mandelate; 10-undecenaldehyde; *p*-xenylamine; *R*. DL-Xylose.

In the case of neutral glass tubing, the minimum diameter of tubing to which the exemption relates is reduced from 8 mm. to 3 mm.

US Records Peak Production of Coal Chemicals in 1957

COAL chemical materials produced in the US in 1957 are the subject of a recently published US Department of the Interior, Bureau of Mines' report (M.M.S. No. 2780). Tar (crude) amounted to 873.5 million gall.; ammonium sulphate, or equivalent, totalled 2,027.5 million lb. The yield of coal-chemicals per ton of coal were: tar (crude ex-slot-type ovens) 8.32 gall., ammonium sulphate or equivalent (ex slot-type ovens) 19.56 lb., crude light oil (ex slot-type ovens) 2.94 gall. The value of coal-chemical materials sold or used was: tar (crude), \$46.9 million (used by producers as fuel) and \$57.5 million sold; ammonia (sulphate and liquor) \$30.3 million; crude light oil and derivatives \$78.5 million; and other coal-chemical materials \$26.7 million.

A slight increase in the average yield of the basic coal-chemical material (ammonia, crude tar, crude light oil and coke-oven gas) coupled with a record tonnage of coal carbonised in slot-type ovens resulted in peak production of these chemicals. Ammonia (NH₃ equivalent in all forms) output rose 4 per cent; crude tar, 5 per cent; and crude light oil and coke-oven gas, 3 per cent each. Production of the derivatives from the processing of crude light oil, namely benzene, toluene, xylene and solvent naphtha by coke-plant operators increased 3, 2, 4 and 8 per cent respectively. Production of tar derivatives at coke plants dropped, however, because two companies sold their tar-processing facilities in 1957 to a tar distillery operating inde-

pently of the coke ovens.

Because of high manufacturing costs prices of coke increased during the year. Prices of most coal chemicals, except for ammonium sulphate, remained about the same. The largest increase noted was in the price of oven foundry coke which rose \$2.2 per ton (9 per cent). The price of crude tar increased 8 per cent and averaged \$0.13 per gall. Prices of light-oil derivatives remained about the same during the year, but ammonium sulphate prices dropped for the fourth consecutive year. In fact, the price of ammonium sulphate was so low that four coke plants discontinued its production in 1957. The high cost of sulphuric acid and the low market price made it impracticable for these plants to continue recovering this material from their coke-oven gas.

The total value of coal carbonised was over \$1 million. The value of all coal-chemical materials used and sold and coke and breeze produced amounted to \$1.818 million or 71 per cent more than the cost of the coal. Coke and breeze supplied 78 per cent of the dollar value of all products while coal-chemical materials supplied the remainder or 22 per cent.

According to the Tariff Commission US imports of coal tar chemicals in 1957 amounted to 11.9 million lb., compared with 6.7 million lb. in 1956.

Over two-fifths of all the intermediates imported in 1957 came from Western Germany, which supplied 4.9 million lb. Imports from the UK were 1.4 million lb.

Kanigen-Treated Guided Missile Parts to be Shown at Farnborough

GUIDED missile components and aircraft parts treated by the new Kanigen chemical nickel-phosphorus plating process will be shown at Farnborough this year on the stand of Albright and Wilson (Mfg.) Ltd., who are operating the process under licence at their Oldbury, Birmingham, works.

Examples will include a fly-off body used in the Thunderbird ground-to-air missile, and stainless steel convoluted tube, Kanigen-plated to stop the fretting corrosion between the tube and the armoured braid often associated with conventional types of this tubing used as feedbacks in hydraulic systems in aero engines.

Following research work in the Albright and Wilson research laboratories during the past year, the Kanigen process can now be used for plating non-metallic materials such as plastics, ceramics and glass.

New Radioactive Material Handling Company

NEGOTIATIONS concerning the formation of a jointly owned British-American company to design and market remotely controlled equipment for handling radioactive materials in nuclear establishments are nearly completed, it has been announced. Partners will be Savage and Parsons Ltd., Watford, Herts, and the mechanical division of General Mills Inc., of Minneapolis.

The new firm will supply mechanical and powered manipulators, reactor fuel loading and unloading systems, reactor maintenance systems, and other remote handling apparatus and ancillary protective equipment. One of the reasons given for the formation of the new company is the increasing demand for this equipment overseas within the past twelve months.

Ramsay Memorial Fellowships

The Ramsay Memorial Fellowships Trustees have awarded new fellowships in chemistry for 1958-59: to Mr. G. S. Laurence, a general fellowship at the University of Leeds; Madame Mouseron Canet, a French fellowship at the Imperial College of Science and Technology, London; Dr. R. Rodriguez Martinez, a Spanish fellowship at the Atomic Energy Research Establishment, Harwell, and Rothamsted Experimental Station; and Mr. Phillip G. Thompson, US fellowship at the University of Cambridge.

Pharmaceutical Society Buys London Headquarters

After being tenants of their Bloomsbury, London, headquarters for 117 years, the Pharmaceutical Society of Great Britain has bought the building from the Bedford estate for £230,000.

Commercial News

W. J. Bush and Co.

While increased turnover and profits for the year ending 31 December 1957 were reported by Mr. Eric L. Bush, chairman of W. J. Bush and Co. Ltd., he warned that the first five months of the present year had been on a less satisfactory level, by reason of some fall in exports while the company was faced with operating expenses on an increasing scale.

For the year 1957, trading profit increased from £656,600 to £867,683, net profit rising by £69,833 to £312,837. During the year, £124,646 was spent on new buildings, plant and equipment for the group.

A final dividend of 11 per cent, making 13 per cent for the year, is being paid.

Courtaulds Ltd.

Courtaulds' wholly-owned subsidiary, Group Developments, has offered to purchase the £160,000 ordinary capital of Cellon at a price of 20s per 5s share, or a total of £640,000. Cellon's manufacture aircraft finishes, lacquers, paints, etc.

The offer is conditional on 90 per cent acceptance before 26 August or such less percentage as may be accepted as sufficient. Acceptance is being recommended by the board of Cellon, whose chairman is Mr. J. Duncan Ferguson.

Courtaulds' chairman, Sir John Hanbury-Williams reported at last month's Courtaulds' annual general meeting that none of the conditions which were prerequisite to success was lacking, and his company confidently anticipated 'a progressive widening of the group's interests.'

Quickfit and Quartz

Thomas Tilling, acting on behalf of James A. Jobling and Co., have reached an agreement with Triplex Holdings under which Joblings will acquire from Triplex the capital of Quickfit and Quartz, the manufacturers of laboratory and scientific glassware and glass industrial plant. The purchase will involve £240,000 in cash and the issue to Triplex of 144,000 ordinary shares of Thomas Tilling at 50s per share, against a market price of 53s 6d.

It is stated that a consolidation of the scientific and industrial glass interests of Joblings with those of Quickfit and Quartz and its subsidiaries will benefit the manufacturing and marketing of their products, nearly half of which are exported.

Triplex Holdings Ltd.

A special interim dividend of 7½ per cent is declared by Triplex Holdings (formerly Triplex Safety Glass Co.) in

- Bush's Increased Profits and Turnover
- Courtaulds' Offer £640,000 for Cellon
- Jobling's to Acquire Quickfit Capital
- CDC Interest in Trinidad Fertiliser Firm

addition to maintaining the dividend at 20 per cent for the year ended 30 June 1958.

Group surplus in 1957-58, expanded from £911,062 to £1,400,672 and the net surplus from £311,788 to £466,557. Of the £268,333 against £168,821 attributable to the parent company, the 20 per cent dividend absorbs £116,488.

George Kent Ltd.

Industrial instrument manufacturers, George Kent Ltd., report a profit for the parent company after tax for the year ended 29 March 1958, of £265,749 (£204,160). Group profit was £213,793 (£160,946). The charge for estimated UK income tax for 1958-59 is £218,405.

Dividend totals 17 per cent (17½ per cent, including bonus of 2 per cent (2½ per cent)).

Pye Ltd.

Group profits of Pye, radio and electrical engineers and scientific instrument makers, are £1,660,592 compared with £1,680,660 for the year to 31 March 1958. These are subject to tax of £929,000 against £941,827. The balance attributable to the company, after minority interests, is down from £685,072 to £590,064. Dividend of 12½ per cent for the year is being maintained on the deferred and 'A' deferred ordinary. Holders of the 8 per cent participating preferred ordinary again receive a 10 per cent total.

Group turnover has been fully maintained but home profit margins have been materially lower, and due to increased borrowing and higher rates, interest charges have risen by over £100,000.

Vitamins Ltd.

Group profit for Vitamins Ltd. was £329,464 (£357,988) for the year to 31 March 1958. Tax absorbed £183,303 (£167,579).

A dividend of 20 per cent is being paid on the £569,000 ordinary capital as increased by a one-for-three 'rights' issue and the issue of 196,000 shares, of 5s to the pension fund trustees. This compares with a forecast of 17½ per cent, the rate paid on the £390,000 capital for 1956-57.

Powell Duffryn

Powell Duffryn profits for the year ended 31 March 1958, after deducting interest on debenture stock, directors' remuneration, and profits attributable to outside shareholders, amounted to £2,032,709 (previous year £2,199,237). Depreciation charged was £844,181

(£753,672), and after taking credit for £221,000 (1957, £95,000) of relief arising from investment allowances on capital expenditure, meeting taxation at £969,046 (£1,176,398), and adding a transfer from taxation reserves of £150,000 (£178,000), the total consolidated net profit was £1,213,663 (£1,216,433).

Payment of a final dividend of 10 per cent (less income tax) is on the 9,660,471 ordinary shares of 10s each is recommended, making with, the 6 per cent interim, 16 per cent for the year.

Federation Chemicals Ltd.

Colonial Development Corporation is to buy £1 million sterling notes in Federation Chemicals Ltd., which are to establish a fertiliser factory at Point Lisas, Trinidad. Federation Chemicals are a newly-formed company sponsored by W. R. Grace and Co. of New York.

Guardian Chemical Corp.

Guardian Chemical Corporation, Long Island City, New York, have acquired the controlling interest in Shield Chemical of Toronto, according to an announcement by Alfred R. Globus of Guardian Chemical.

Pechiney

Turnover of Pechiney, of Paris, manufacturers of chemical and electro-metallurgical products, for 1957 rose by 22 per cent and exports accounted for over 20 per cent of the increase, net profits amounted to Frs.2,369,418,194; a gross dividend of Frs.450 in respect of old shares corresponding to a gross dividend of Frs.339 in respect of new shares is to be distributed.

Aluminium output reached 132,000 metric tons—as against 128,000 tons in 1956. Output of rare metals was maintained at a normal level and sales of chemical products showed an increase of 25 per cent over those for 1956. Plans have been finalised for the building of a new electrolysis plant to be pioneered by natural gas from the Lacq deposits. It is expected to begin production early in 1960.

Saint-Gobain S.A.

Chemicals and glass manufacturers, Saint-Gobain, Chaury and Cirey, Paris, report that work continues on a number of contracts awarded in 1956. These include the erection of a sulphuric acid and phosphate fertiliser plant and the construction of a nitrogenous chemicals plant in Mexico in collaboration with

other companies. Two further contracts have recently been signed for the erection of nitrogenous fertiliser plants in India and Pakistan.

Sales of the chemical division increased by 20 per cent, organic chemicals alone rising by 40 per cent. The recent installation of a new plant to produce chloride by electrolysis enabled output of this chemical to be increased by 30 per cent. Prices of organic chemicals did not fall as expected but competition has remained fierce.

Saint-Gobain's p.v.c. plant was fully utilised throughout the year, and output increased by 50 per cent. Even more striking results were obtained in the sales of polyester resins, which rose by 180 per cent.

Net profits amounted to Frs. 1,905,370,614 (£1,905,400 approximately), Frs. 1,864,175,509 (£1,864,000 approximately) is being distributed in the form of a net dividend of Frs. 561 per share.

International Nickel of Canada

For the first time in 18 years, with the exception of the period 1946-9, the supply of nickel exceeds world demand and the industry has reverted to its 'historical condition', says Mr. John F. Thompson, chairman of the International Nickel Company of Canada, Ltd., in a letter to shareholders.

The sales drive is to be intensified in view of the forecast that nickel production in the free world will reach 650 million lb. in 1961—about 235 million lb. more than consumption for both

civilian and defence purposes in 1957. International Nickel's production capacity in 1961 will be at the annual rate of 385 million lb. from its operations in the Sudbury district of Ontario and the new Thompson mine.

The rate of nickel deliveries in all forms during the first six months of 1958 was 35 per cent down on the corresponding period last year. Copper and platinum deliveries were also down. The persisting

lower level of demand and the continued increase in the stocks of unsold nickel cause the company to reduce the rate of production for the third time this year. As from July, the annual production rate is to drop to 200 million lb. each of nickel and of copper.

Net profit for the first six months of 1958 was down to \$21,401,000 (£7,640,000), compared with \$45,601,000 (£16,286,000) for the first half of 1957.

Market Reports

STEADY TRADE IN INDUSTRIAL CHEMICALS

LONDON There has been little change in the position of the industrial chemicals, and most sections of the market remain quiet with prices steady at recent levels. Steady conditions also prevail in the market for agricultural chemicals which are subject to seasonal influences. Export trade continues to be satisfactory. There has been a fair outlet for most of the coal tar products but the market is without feature.

MANCHESTER Trading on the Manchester market for heavy chemical products has been rather more active, due principally to less interruption of operations at the consuming end as the result of holidays. The demand from the textile and allied industries continues on a reduced scale, but other industrial outlets are calling for somewhat better deliveries against contracts, and some

improvement in the number of inquiries circulating compared with recent weeks is reported. Apart from early delivery transactions the fertiliser section is on the quiet side. The light and heavy tar products are mostly meeting with a fair demand.

GLASGOW With the resumption after the holiday period, business in the Scottish heavy chemical market showed a little improvement towards the end of the week. Demands were for the usual range of chemicals, both in regard to spot and contract requirements. There was no significant price change and in the majority of cases prices remained firm.

The overseas market is still fairly active, with a fair volume of inquiries being received. There is continued business in agricultural chemicals.



Ladies are to be admitted

"The 'Female Physicians' question, thanks to Professor Masson, has made a great stride during the past week. Ladies are to be admitted to study Medicine at Edinburgh University. Imagine the feelings of the non-contents when Professor Masson, in a final outburst, described their argumentation as 'rampageous mysticism, dashed with drivel from Anacreon!'" (Nature, 1869, 1, i, 25)

In 1869 scientific clinical methods were nearly as unpopular as women doctors. Today men and women work together in clinical, bacteriological and pathological laboratories all over the world; and in more than seventy countries regard the products of the B.D.H. Laboratory Chemicals Group with equal favour.

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TRADE NOTES

Henry Wiggin's Exhibitions

A series of four-day exhibitions devoted to the practical uses of nickel and its alloys are to be held in Newcastle, Leeds and Belfast, during September and October by Henry Wiggin and Co. Ltd. The first will be at the Royal Station Hotel, Newcastle-upon-Tyne from 23 to 26 September; the second at the Metropole, Leeds, from 14 to 17 October, and the final one from 28 to 31 October at the Grand Central Hotel, Belfast.

In the chemical section, a wide range of typical components made from Wiggin alloys—mainly Monel, nickel and Corronel B—will illustrate the ease with which they can be fabricated and the value of their special characteristics, with particular emphasis on corrosion-resistance.

Ozonification Plant

Equipment for the electrical ozonification of air and water by the 'Blatter' system of silent high-tension discharge is to be made and marketed in Britain for the first time by J. Brockhouse and Co. Ltd., 25 Hanover Square, London W1. The system is designed for the removal of unpleasant smells in industrial, business and social premises.

Subsidiaries Reorganised

The British subsidiary of Stone and Webster Engineering Corporation, E. B. Badger and Sons Ltd., has now changed its name to Stone and Webster Engineering Ltd. This change is part of a general expansion of the Corporation's foreign subsidiaries. The Corporation has also formed a Netherlands subsidiary to be known as Stone and Webster Engineering NV.

The Australian company known as E. B. Badger and Sons Pty. Ltd. has become Stone and Webster Pty. Ltd.; the French subsidiary, Etablissements Badger, S.A., becomes Stone and Webster Engineering S.A.

Denso in Canada

As Denso anti-corrosion products are now well established on the Canadian market, the manufacturers, Winn and Coales Ltd., Denso House, Chapel Road, London SE27, have formed in collaboration with their main Canadian agents a new company, Denso of Canada Ltd., with head offices at 47 Cranfield Road, Toronto.

Rocol's Canadian Agents

Following a recent tour of Canada by the sales director, Mr. J. G. Gershon, Rocol Ltd., Rocal House, Swillington, near Leeds, have appointed International

Agencies and Machinery Co. Ltd., 2315 Cambie Street, Vancouver, to be their agents for British Columbia, and W. R. Watkins and Co. Ltd., 41 Kipling Avenue South, Toronto 18, agents for the rest of Canada. Rocol are manufacturers of specialised molybdenised and other lubricants.

Glycerine Regraded

Glycerine hitherto sold by members of the UK Glycerine Producers' Association as 'pale straw' will in future be known as 'technical grade,' and the specific gravity of both 'chemically pure' and 'technical grade' glycerine has been increased from 1.260 to 1.2627, corresponding to a glycerol strength of 99 per cent. Prices are not increased.

Cyanuric Acid Distributors

The Food Machinery and Chemical Corporation, 161 East 42 Street, New York 17, US, has appointed the Cocker Chemical Co. Ltd., Oswaldtwistle, Lancs, exclusive distributors for cyanuric acid, chlorinated cyanuric acids and derivatives. FMC plan to have these products available in commercial quantities for export to the UK early in 1959. This distributorship agreement has been entered into with a view to the setting-up in due course of manufacturing facilities in the UK which would be operated as a joint venture by the two companies.

Cheaper DCL Plasticisers

The Chemical Division of the Distillers Co. Ltd. has reduced the spot prices of its phthalate plasticisers by £8 to £17 10s per ton with effect from 11 August. In addition, rebates of up to £4 per ton are given for large purchases over a period.

The plasticisers in question are: in the Bisoflex range, 81, 88, 91 and 791, and dimethyl phthalate, diethyl phthalate, di-isobutyl phthalate and dibutyl phthalate.

Representative Appointed

Charles Hearson and Co. Ltd., complete laboratory furnishers, of Willow Walk, London SE1, announce the appointment of Mr. Ronald Sealy as technical representative. Mr. Sealy will be joining Mr. John Stow, in the Greater London area, in order that the company's policy of maximum liaison with the user may be more fully implemented.

Phthalate Plasticiser Prices Cut

New production facilities at Widnes have led A. Boake Roberts and Co. Ltd, London E15 to make substantial reductions in the prices of ABRAC

phthalate plasticisers. The new high-efficiency plant now in operation will, it is said, provide increasing quantities of exceptionally high quality material at prices comparable with those enjoyed overseas. The effective changes, which apply to all orders despatched on and after 11 August are:

	Reduction per ton
Di-iso-butyl phthalate	£6 0s
Di-n-butyl phthalate	£10 0s
Diethyl phthalate	No change
Dimethyl phthalate	No change
Dinonyl phthalate	£14 10s
Di-2-ethylhexyl phthalate	£10 10s
Di-iso-octyl phthalate	£15 10s
Phthalate 79	£15 10s
Phthalate 979/ME	£15 10s

In addition, rebates amounting to a maximum of £4 a ton are available to large purchasers.

Changes of Name

Laboratory Accessories Ltd., 26/7 D'Arblay Street, London W1, have changed their name to T. H. Williamson Ltd.

Aero Chemicals Ltd., Newport House, Great Newport Street, London, WC2, have changed their name to Kearsley Aero-Chemicals Ltd.

F. Hewthorn and Company Ltd., Unilever House, Blackfriars, London EC4 have changed their name to British Extracting Company (Sales) Ltd.

Changes of Address

Climax Molybdenum Co. of Europe Ltd., are moving to 2 Cavendish Place, London W1 on 1 September; telephone Museum 8818.

Incorporated Plant Engineers moved on 6 August to new head offices at 2 Grosvenor Gardens, London SW1.

Servo Units

Harvey Electronics Ltd. have formed a new subsidiary, Servo Units Ltd., at 273 Farnborough Road, Farnborough, Hants, to handle all their servo mechanism work. First new products are to be a series of fully transistorised power servos giving stalled torque output of up to 5 lb.-ft.


Wills

MR. HARRY CHARLES WOOD, O.B.E., sales director and secretary of Graesser Salicylates Ltd., Sandycroft, near Chester, who died on 10 December, 1957, left £12,410 net.

MAJOR FRANCIS HERBERT BRAMWELL, late director of the Power-Gas Corporation Ltd., and Ashmore, Benson, Pease and Co. Ltd., and former chief engineer of ICI General Chemicals Division, who died on 7 May, left £36,448 net.



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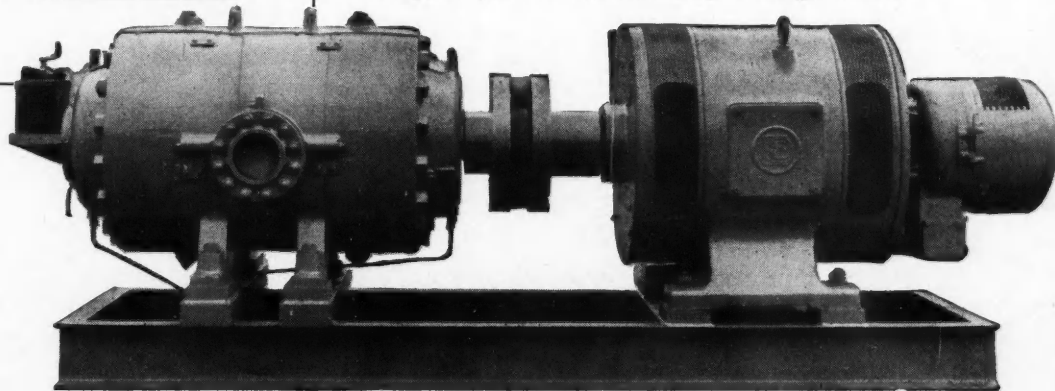
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NEW PATENTS

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Specifications filed in connection with the acceptances in the following list will be open to public inspection on the dates shown. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period.

AMENDED SPECIFICATIONS

On sale 17 September

O, o-dimethyl-o-(6, 6-1-ethylvinyl)-phosphate. Farbenfabriken Bayer AG. 771 634

ACCEPTANCES

Open to public inspection 17 September

Promoted heat interaction of vulcanisable elastomers with mineral fillers. Esso Research & Engineering Co. 801 729
Organosilicon resins. Midland Silicones, Ltd. (Dow Corning Corp.). 801 529
Lysine-yielding hydantoins and of lysine therefrom. Du Pont de Nemours & Co., E. I. 801 530
Alkyl aluminium compounds. Dow Chemical Co. 801 674
Extraction of chlorine from gaseous mixtures. Cathala, M. E. J. 801 730
Bituminous plastisols. De Bataafsche Petroleum Maatschappij N.V. 801 499
Stabilised liquid sulphur trioxide. Olin Mathieson Chemical Corp. 801 731
Process of coating polymeric substrates. Du Pont de Nemours & Co., E. I. 801 531
Producing polyalcohols by hydrogenation of corresponding sugars. Usines de Melle. 801 732
Process for the staged catalytic cracking of hydrocarbon oils using finely divided solid catalyst. De Bataafsche Petroleum Maatschappij N.V. 801 656
Lower alkyl 4-phenyl-1-(hydrocarbyl) piperidine-4-carboxylates and the preparation thereof. Sterling Drug, Inc. 801 577
4-Aryl-1-(substituted)-piperidine-4-carboxylates and their preparation. Sterling Drug, Inc. 801 578
Manufacturing carbon monoxide. General Aniline & Film Corp. 801 657
Preparation of 1, 2, 3, 4, 7, 7-hexachlorobicyclo (2,2,1)-2, 5-heptadiene. De Bataafsche Petroleum Maatschappij N.V. 801 677
Salts of disubstituted carbamic acid esters and a method for the production thereof. Hoffmann-La Roche & Co. AG, F. 801 533
Manufacture of 7-substituted-theophylline compounds. Roche Products, Ltd. [Addition to 761 944.] 801 679
Plasticised and heat and light stabilised polymeric compositions. Union Carbide Corp. 801 700, 801 701, 801 702
Fermentation. Hoffmann-La Roche & Co. AG, F. 801 612
Polyvinyl acetate emulsions with positively charged particles. Shawinigan Chemicals, Ltd. 801 580
Preparation of a coating material from polyamides with aqueous 2-chloroethanol as a solvent. Algemene Kunstzijdeunie N.V. 801 475
Preparation of an unsymmetrical dialkylhydrazine. Olin Mathieson Chemical Corp. 801 534
Producing trichloroethylene from tetrachloroethane. Columbia-Southern Chemical Corp. 801 680
Fluidised solid reactions. Bergwerksverband zur Verwertung von Schutzrechten der Kohlenteknik G.m.b.H. 801 476
Steroids and the manufacture thereof. Upjohn Co. 801 503
Production of polyamides. Badische Anilin- & Soda-Fabrik AG. 801 733
Antibiotically active derivatives of spiramycins. Soc. des Usines Chimiques Rhone-Poulenc. 801 536

Production of alkoxyglycerolesters from lipid mixtures. Kabi Aktiebolaget. 801 582
Alkylation with effluent refrigeration and flashed vapour absorption. Texaco Development Corp. 801 646
Apparatus and method of fermenting beer. Anheuser-Busch, Inc. 801 658
Carbonylation synthesis reaction. Esso Research & Engineering Co. 801 734
Process and apparatus for degasifying molten metal. Dortmund-Hörder Hüttenunion AG. 801 518
Production of edible protein products from fish solubles. Joymol (Proprietary), Ltd. 801 553
Carotenoid and a process for the manufacture of same. Hoffmann-La Roche & Co. AG, F. 801 736
Preparation of isonicotinic acid hydrazide. David, Ltd., A., and Mukherjee, S. L. 801 537
Production of cycloaliphatic nitrates. Badische Anilin- & Soda-Fabrik AG. 801 737
Allylidene dicarboxylates and process for their production. Union Carbide Corp. 801 706
Organohaloborines and the production thereof. Olin Mathieson Chemical Corp. 801 707
Thermal cracking of liquid hydrocarbons. Chemische Werke Hüls AG. 801 708
Steroids and the manufacture thereof. Upjohn Co. 801 614
Coating of organic polymer substrates. Du Pont de Nemours & Co., E. I. 801 479
Organosilicon polymers. Midland Silicones, Ltd. 801 709
N-polyoxyalkylene derivatives of heterocyclic amines. Dow Chemical Co. 801 710

Open to public inspection 24 September

Bonding of rubber to metal. Dunlop Rubber Co., Ltd. 801 928
Production of heat-resistant materials. Walker Extract & Chemical Co., Ltd. 801 929
Apparatus for emptying containers of iron oxide or the like. Newton, Chambers & Co. Ltd. [Addition to 747 964.] 801 930
Process for obtaining a dry powder from a solution or suspension of a solid by centrifugal atomisation. Rubber-Latex-Poeder-Compagnie NV. 802 001
Apparatus for converting liquids, solutions, emulsions, suspensions, and the like into dry powders. Rubber-Latex-Poeder-Compagnie NV. 802 002
Aluminium paints. National Research Development Corp. 801 986
Treatment of proteinaceous textile materials to render them shrink-resistant. Rohm & Haas Co. 801 987
Process for treating aromatic-diolefin mixtures. American Oil Co. 801 801
6-Methyl-steroid compounds. British Drug Houses Ltd. 802 003, 802 004, 802 005
Compositions and processes for the production of expanded thermoplastic materials. Whiffen & Sons, Ltd. 801 825
Heater for coppers for wort and other liquids. Adlam & Sons, Ltd., G. 801 933
Neutralising agents for permanent waving of human hair. Evans Chemetics, Inc. 801 990
Treatment of slags. British Iron & Steel Research Assoc. 801 883
Production of substituted acid amides. Badische Anilin- & Soda-Fabrik, AG. 801 991
Heterocyclic nitrogen-containing compounds having a 3:4:5-trimethoxybenzoyl substituent. Smith & Nephew, Ltd., T. J. 801 791
Production of artificial filaments and films from viscose. Vereinigte Glanzstoff-Fabriken, AG. 802 013
Apparatus for use in catalytic processes. Imperial Chemical Industries, Ltd. 801 806
Preparation of cyanocarboxylic acids. Perfogit Soc. Per Azioni. 802 016
Methods of producing coated fabrics. United States Rubber Co. 801 938
Metallisable monoazo dyestuffs of the benzene-azo-4-hydroxybenzothiazole series. Imperial Chemical Industries, Ltd. 801 900
Stabilisation of unvulcanised rubber. Smith & Nephew, Ltd., T. J. [Cognate application 15 489.] 802 018
Regenerated cellulose films. Du Pont de Nemours & Co., E. I. 801 992
Steroid compounds. British Drug Houses, Ltd. 801 793

Dioxalones. Spence & Sons, Ltd., P. 802 022
Comminuted metal and plastic material containing epoxide resins. Chemical Development Corp. 801 826
Steroid compounds. British Drug Houses, Ltd. 801 794
Compositions for use as local anaesthetics. May & Baker, Ltd. 802 023
Plastisol mixtures. United States Rubber Co. 802 070
Process for treating solid materials. Texaco Development Corp. 801 940
Suspension polymerisation. Dow Chemical Co. 802 061, 802 062
Production of lyophilised preparations. Farbenfabriken Bayer, AG. 801 826
Dense liquid separating apparatus. Jaruzs A. G. Chur. [Addition to 685 071.] 801 789
Production of phosphate and thiophosphate esters containing a heterocyclic nitrogen ring. American Cyanamid Co. 801 942
Vaccine products and method for producing the same. Parke, Davis & Co. 802 040
Method and apparatus for laminating thermoplastic film sheets. Dow Chemical Co. 802 030
Preparation of oil-soluble metal naphthenates. Esso Research & Engineering Co. 801 827
Washing or bleaching process and a washing and bleaching composition for use therein. Deutsche Gold- und Silber-Scheideanstalt Vorm. Roessler. 802 035
Copolymerisation. Chemische Werke Albert. 801 795
Recovery of pure phenol from crude phenol. Rutgerswerke AG. 802 054
Liquid dispenser. D. K. Manufacturing Co. 801 872
Aromatic amines. Imperial Chemical Industries, Ltd. [Cognate application 12 004.] 802 036
Steroid compounds. Merck & Co., Inc. 801 829
Producing alumina. Universal Oil Products Co. 801 760
Apparatus for measuring out and discharging fluent solid bulk material. Hesser, Maschinenfabrik AG, F. 801 940
Chloridising roasting of raw materials containing iron and non-ferrous metals. Badische Anilin- & Soda-Fabrik AG. 802 037
Polymerisation of ethylene. Du Pont de Nemours & Co., E. I. 802 037
Fuel compositions. De Bataafsche Petroleum Maatschappij NV. [Addition to 754 733.] 801 830
Continuous production of high linear condensation polymers. Du Pont de Nemours & Co., E. I. 801 813
Distillation of coal tar. Rutgerswerke, AG. 801 947
Non-blocking polyethylene compositions. Union Carbide Corp. 802 059
Production of colloidal soluble aluminium hydroxide. Badische Anilin- & Soda-Fabrik AG. 801 833
Avoiding formation of scale and corrosion in the economisers for steam boilers. National Aluminate Corp. 802 006
Treatment of slags. British Iron & Steel Research Assoc. [Divided out of 801 883.] 801 834
Purifying dimethyl terephthalate by distillation. Vereinigte Glanzstoff-Fabriken, AG. 802 067
Magnesium alloy. Dow Chemical Co. 801 865
Modified methylol ethers. Rohm & Haas G.m.b.H. 802 066
Ethylene polymers. Union Carbide Corp. 801 834
1-nitroso-1, 3-D1-(carboxyalkyl) ureas. Monsanto Canada, Ltd. 801 893
Manufacture of cyanofornamide. American Cyanamid Co. 801 955
Preparation of 2-methyl-2-phenyl-1, 3-propanediol dicarbamate. Carter Products, Inc. 801 915
Urea derivatives. Monsanto Canada, Ltd. 801 899
Proteolytic enzyme compositions. National Drug Co. 802 069
Production of 1-nitro-naphthalene-3, 6- or 7-disulphonic acid. Farbenfabriken Bayer AG. 801 780
Preparing methyl ethyl ketone from secondary butanol. Esso Research & Engineering Co. 801 880
Aluminium-base alloys. Kawecki Chemical Co. 801 910
Transfer line chemicals coking process. Esso Research & Engineering Co. 801 917
Method of desulphurising hydrocarbon oil. Standard Oil Co. 801 955
Heterocyclic nitrogen-containing compounds. Smith & Nephew, T. J. [Divided out of 801 791.] 801 792
Copolymerisation. Chemische Werke Albert. [Divided out of and addition to 801 795.] 801 790

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